THE TELEGRAPHIC JOURNAL AND

# Electrical Review.

VOL. XVI.—No. 383.

## THE TELEPHONE MONOPOLY.

LAST week we commented upon the fact that the telephone is not so well known and generally used in England as it should be, stating our belief that one great reason for this is to be found in the circumstance that the United Telephone Company and its subsidiaries hold a practical monopoly. This monopoly, like most others, makes itself felt in various ways: and now we have to call attention to what we cannot refrain from calling a gross abuse of its imagined powers. Generally speaking, the sense of security created by sole rights in any direction is apt to engender a somewhat looser method of management than would prevail in the presence of a healthy competition, and a defective service and considerable inconvenience to those who are obliged or who find it to their interest to make use of the particular commodity concerned, naturally follows. This has been conspicuous in the history of the United Telephone Company, and we have not failed from time to time to give expressions to the by no means unfrequent complaints which have reached us of the disregard shown for the convenience and requirements of subscribers. Now again we feel called upon to protest against the ruthless manner in which are ignored the ordinary considerations of fairness and justice between a service of some utility and the public which subscribes to it.

Some of our readers have probably received copies of the pamphlet prepared by Messrs. J. Travers and Sons, of 119, Cannon Street, E.C., containing the correspondence which has passed between that firm and the United Telephone Company and the Post Office. Messrs. Travers and Sons' grievance is that their establishment, being high, flat-roofed, easy of access, and in a direct line between an exchange and some of the most populous parts of the city, has, contrary to their desire and in spite of their repeated adverse protestations, been made use of for the erection of attachments for running the wires of other subscribers; that this course of action was persisted in until legal proceedings were threatened; and that then, refusing to comply with the terms of an altered form of contract, giving the company the right to enter their premises at all times and to erect such appliances as it might think fit for running wires other than their own, their communication with the exchange was severed, three months before the expiration of the period for which rent had been prepaid. Such, briefly put, are the circumstances which have led this energetic firm to pursue a course no doubt unanticipated by the Telephone Company, and which has probably brought it to a sense of the fact that a grave mistake has been committed. Messrs. Travers point out, in justification of their refusal to permit wires to be attached to their premises, that they are not freeholders and have no power to make such concessions, their landlords, moreover, objecting; that their premises are but too well suited to the purpose to make it desirable to grant the concessions, an accumulation of wires of dangerous proportions being threatened; that they have already suffered great annoyance from the overhead wires erected and the consequences involved; and that they have proof of the absolute danger of the wires, posts, and cables in case of fire, high winds, snow storms, and lightning.

The most objectionable clauses in the new form of contract which Messrs. Travers and Sons have been requested to sign are clauses 5 and 12, which are as follow:—"5. The renter shall permit the company, its agents, and workmen to have access *at all times* to his premises, *and to every other place under his control*, through or over which any part of the said wire or apparatus passes, or to which any part of the said wire or apparatus is fixed." "12. The renter covenants to give every facility in his power in the way of poles, attachments, &c., to the company for running his own wire, and *also those of other subscribers to the company's system, whether exchange or private.*" In the old contract there was a clause stipulating for the company the right to enter the renter's premises to inspect or repair his own instrument at all *reasonable* times; but in the clauses given above there is no such qualification, and those subscribers who are not prepared to permit the erection over their premises of as many wires as the company finds convenient, and to give freedom of access at all hours of the night and day to men (who may or may not be) connected with the Telephone Company, may expect to have their instruments withdrawn and their connection with the exchange terminated.

If the company is to carry out its service it must of course obtain, by some means or other, the facilities necessary for running its wires. The difficulties thrown in its way have been numerous, and the objections which have been urged in many instances against the granting of way-leaves have been exceedingly absurd; but all sympathy which might have been entertained must be estranged by the adoption of such an arbitrary method of achieving the desired end. The pettiness and the folly which has characterised the conduct of the company in regard to the case of Messrs. Travers & Sons must be sufficiently patent, and we forbear remarking further upon it. But an important public question is involved which will sooner or later have to be settled. Seeing that the company *does* possess a monopoly in telephonic service, should there not be a countervailing incumbency upon it to furnish the advantage of connection with its exchange to any *bonâ fide* applicant without the imposition of such ridiculous terms? We may remark that the question has arisen in America, and has been settled as we should have expected. A man in Nebraska was eager to obtain an instrument, and, upon being refused one on the usual terms by the Nebraska Telephone Company, carried

the matter to the law courts, with the result that a verdict in his favour was given by the Supreme Court of the State.

MESSRS. Travers communicated with the Postmaster-General after they had been refused further connection with the United Company's exchange, asking whether he could suggest any course by which they could retain the advantages of telephonic communication without subscribing to what appeared to them the very unreasonable demand of the United Company. In this letter they stated that in consequence of the glut of work at the Company's exchange it often saved time to send a messenger to the person desired to be communicated with instead of waiting to be switched on to the proper wire. To obviate this difficulty they suggested the opening of special exchanges by the Post Office in the great City markets. The reply to this was to the effect that the Post Office would be prepared to proceed in the matter of establishing a telephone exchange in or about Mark Lane for the accommodation of the brokers and merchants in that locality, provided at least fifty subscribers were obtained. Suggested articles of agreement were forwarded, but the terms of these, though varying considerably from the contract of the United Telephone Company, are in some particulars so onerous that we much doubt if fifty persons could be found to subscribe to them. At the same time we are informed that these articles were in no wise to be considered as final, and that the Post Office would be quite willing to entertain the suggestion of modifications. Still, we scarcely anticipate the immediate opening of exchanges in London by the Post Office, and we are inclined to the belief that the Telephone Company, recognising the futility of the course it has proposed to adopt, will prove amenable to reason and abate to a considerable extent its unfair demands. This can scarcely be the most favourable time for such an occurrence as far as the Company's interests are concerned, for it cannot be doubted that the attention of the Select Committee sitting upon the question of telegraph and telephone wires will be directed to this incident as illustrative of the fact that there are objections by even subscribers to telephone exchanges to overhead wires.

## ON THE OXIDE OF COPPER BATTERY.*

By Dr. E. VAN DER VEN.

THE study which I published in this journal (Vol. XII., p. 448) has furnished M. de Lalande with a subject for controversy (Vol. XIII., p. 77).

"When we determine," says the learned inventor, "the electromotive force, E, and the resistance, $y$, of any element whatever, *for which these two magnitudes vary with the regime* (and we may affirm that this variation takes place almost generally, save, perhaps, in the case of the Daniell element), we perform two experiments in which the element works against two different external resistances. By means of measurements of intensity, or preferably, as in the experiments of M. Van der Ven, of the difference of potential between two points of the external resistance we obtain two relations between E and $y$.

"But if these two values vary in passing from one regime to another, the two relations thus established permit us merely to find a sort of mean value between the conditions defined by the two experiments. These mean values certainly permit us to calculate the work of the battery against an external resistance comparable to that of the observations, but it is only by means of a real and very uncertain extrapolation that we can apply the constants thus obtained to different circumstances.

"But there is a more important objection to be made to these measurements; that they have been taken on an element which appears to have been charged under conditions quite different from the normal conditions which we have indicated. We recommend the use of a solution of caustic potash containing 30 to 40 per cent., whilst the solution employed by M. Van der Ven contained only 23 per cent. This condition must to a large extent have changed the constants of the battery, and notably its resistance and its total yield."

When the number of the journal containing M. de Lalande's letter arrived at my address, I had set out on a journey for some weeks, and it was only during this absence that I took cognisance of the foregoing.

I was then obliged to content myself with answering as follows (Vol. XIII., p. 237):—

"The result of my experiments, as well as all that has been deduced from them, must be considered as available only in cases where M. de Lalande's battery is employed under circumstances similar to those in which it has acted during these experiments, that is to say, in cases where the external resistance is not more than $\frac{0{\cdot}37}{0{\cdot}075} = 5$ times the internal. And in this case the electromotive force cannot differ notably from 0·66 volt, nor the internal resistance from 0·075 ohm.

"Also, when M. de Lalande says that my experiments render it possible to calculate the work of the battery against a resistance comparable to that of the observations, but that it is only by a real and very uncertain extrapolation that we can apply constants thus determined to different conditions, this remark can only have any reference but to this, that according to me, "it is evident that we cannot make use of the battery for purposes which require a great difference of potential in the different parts of the circuit."

"It may very well be that I had no right to draw this conclusion, which after all only testifies too great confidence in the depolarising action of the oxide of copper by which the rise of a polarisation-current of an intensity varying with circumstances would be absolutely prevented.

"Finally, I must admit that my measurements have been taken with an element charged under different conditions from those indicated by M. de Lalande. The fact is that I misunderstood M. de Lalande when he recommends the use of caustic potash at 30 to 40 per cent. Wishing to follow his directions, I used a solution of 900 grms., caustic potash in 3,800 grms., water, whilst it now seems that the 900 grms. of potash should make part of a total solution of 3,000 grms. Thus the strength has been about 7 per cent. below that specified.

"I make my acknowledgment of this mistake the earlier, because the renovation of my laboratory at Haarlem deprived me of the opportunity of rectifying it immediately. As soon as I get back I hope to submit M. de Lalande's battery to a new examination, in which the conditions will be observed under which the inventor intended it to work."

Immediately on my return I resumed, as I had promised, my researches on this element.

These researches have lasted longer than I expected: a circumstance all in favour of the new element, because this long duration is mainly due to the fact that its electromotive force was almost constant for weeks, even when, for reasons which will appear below, I substituted continuous for intermittent working. It further happened that when the last series of my experiments was completed, researches of another nature compelled me to defer the summarising of the results for more than two months.

It need not be said that I took care not to repeat the error which in my first series of researches reduced my alkaline solution 7 per cent. below the strength which I intended. The present element contains 900 grammes of solid caustic potash, 2,100 grms. of water, and 900 grms. oxide of copper.

In the calculations which will appear in this study I fixed the internal resistance of the element at 0·075 ohm. This value was the mean of my former results, and might be deduced from them with more exactitude than from those the results of which I am about to communicate.

* *La Lumière Electrique.*

For it results from the equation

$$y = \frac{v_2}{v - v_2} l' - l$$

that in the method which I have taken, this exactitude increases with the difference of potential $v - v_2$ between two parts of the external circuit, which, nevertheless, may be separated only by a part of the circuit, the resistance of which, $l'$, is great. And we attain this twofold object only when (as was the case in my former experiments) the strength of the current is great in consequence of the slight external resistance. Therefore as these new series of experiments are only made to see up to what point, with an augmentation of the outer resistance and with a corresponding decrease of the strength of the current, the electromotive force becomes greater, the value of $y$, deduced from our former experiments, will result with more exactness than from those experiments which form the subject of my present researches.

We add, also, that in this study the notations are the same as those employed in the former. Thus $v$ and $v_2$, correspond to the 300th parts of a platinum wire which it was necessary to introduce into the circuit, in the case where it was required to compare the electromotive force of two Bunsen couples respectively at the difference of potential, E, of the electrodes of the element examined, and at the electromotive force, D, of a Daniells element. From these direct experimental data the value, E, has been deduced by means of the equation :

$$E = \frac{v}{v'} D.$$

*First Series.*

Total external resistance ... $l = 11{\cdot}17$ ohms.
Duration of continuous work 240 hours.
Initial value of E ... 0·91 volts.
Final „ „ ... 0·76 „

Mean „ $I = \frac{0{\cdot}84}{l + 0{\cdot}075} = 0{\cdot}075$ amp.

*Second Series.*

Total external resistance ... $l = 2{\cdot}03$ ohms.
Duration of continuous work ... 168 hours.
Initial value of E . . 0·78 volts.
Final „ „ ... 0·78 „

Mean „ $I = \frac{0{\cdot}78}{l + 0{\cdot}075} = 0{\cdot}37$ amp.

*Third Series.*

Total external resistance ... $l = 0{\cdot}978$ ohms.
Duration of continuous work ... 912 hours.
Initial value of E = 0·71 volts.
Final „ = 0·28 „
Mean „ = 0·45 „

Initial „ $I = \frac{0{\cdot}71}{l + 0{\cdot}075} = 0{\cdot}68$ amp.

Mean „ $I = \frac{0{\cdot}45}{l + 0{\cdot}075} = 0{\cdot}43$ „

If we consider the results of these three series and of that published in our former notice it appears that M. de Lalande was perfectly right when he gave prominence to the variability of the electromotive force of his element according to circumstances. In fact, we found successively :

For an intensity of 0·43 ampères E = 0·45 volts.
„ „ 0·68 „ E = 0·71 „
„ „ 0·37 „ E = 0·78 „
„ „ 0·075 „ E = 0·84 „

But it appears also that an electromotive force of 8 to 9 volts corresponds only to current strengths below half an ampère, so that for an Edison lamp which at 13 candles requires a current strength of 0·9 ampères there must be arranged in series a considerable number of elements which will yield a current of the said intensity.

However, this is not the only nor even the most important result which I wish to deduce from these new researches. They have taught me much concerning the proportion which, under different circumstances, exists between the real and the theoretical consumption of zinc in the element.

Even during my first experiments I saw that the real consumption of zinc far exceeded the theoretical consumption. However, I then ascribed this circumstance to the discontinuity of the work, for I had not withdrawn any of the alkaline solution during the hours when the zinc was not at work. During these periods of rest the formation of the zincate went quietly on and must have lasted until the decrease of the quantity of caustic potash in solution put an end to it.

The following experiment proved that this formation is very important at common temperatures.

A small zinc plate which had been exposed for seven days to the action of a 30 per cent. solution of potash, lost in this time 8 grms. of its weight, the immersed surface being 72 square centimetres. When I reweighed this plate some days later, I found that it had lost no more of its weight. Though it had been amalgamated it appears that the layer of amalgam had quickly disappeared, especially on the lower surface, which was turned towards the oxide of copper.

It follows from this experiment that, all other circumstances being equal, the zinc plate which we made use of in the element and the immersed surface of which was 1,440 square centimetres, may have lost 160 grms., the consumption of which has not contributed to the production of electric energy.

Let us now see what the three new series teach us concerning the quantity of zinc at the expense of which the electric energy has been obtained.

*First Series.*

0·075 ampère during 240 hours = 18 ampères per hour.

As the production of an ampère for an hour requires the consumption of 1·23 grms. of zinc in the element, the theoretical consumption will be

$$18 \times 1{\cdot}23 \text{ grms.} = 22{\cdot}14 \text{ grms.}$$

The zinc plate weighed

Before the experiments ... ... 2,325 grms.
After ... ... ... ... 2,207 „

So that the real consumption has been 118 grms., or more than *five* times the theoretical consumption.

*Second Series.*

0·37 ampère during 128 hours = 62·16 ampères per hour.

Theoretical consumption : $62{\cdot}16 \times 1{\cdot}23$ grms. = 80·5 grms. zinc.

As the plate of zinc weighed

Before the experiments ... ... 2,307 grms.
After ... ... ... ... 2,034 „

the real consumption has been 272·5 grms., *i.e.*, it is *three* times greater than the theoretical consumption.

*Third Series.*

0·43 ampère during 912 hours = 392·16 ampère per hour.

Theoretical consumption : $392{\cdot}16 \times 1{\cdot}23$ grms. = 482·4 grms. of zinc.

The zinc plate weighed

Before the experiments ... ... 2,210 grms.
After ... ... ... ... 1,732 „

so that the real consumption has been 479 grms., or very nearly equal to the theoretical consumption.

On comparing these three results we see that under the arrangements adopted in the last instance the electric energy has been obtained in the least costly

manner, so that by means of an element fitted up in the manner indicated the chemical energy is so much the less perfectly converted into electricity as the yield falls below 0·67 ampère during the period when the alkaline solution is still strong enough to favour the gratuitous formation of zincate.

Experiment has shown M. de Lalande that the yield must not exceed 1 to 1½ ampère per square decimetre of active depolarising surface "if we do not wish that this surface should be too small to prevent the development of a notable polarisation current." This experiment indicates a superior limit for the yield depending on the dimensions of the element, whilst our experiments indicate the inferior limit of the strength of the current, a limit which in an element of any dimensions, but charged with an alkaline solution of 30 per cent., cannot be reached without effecting the production of electricity in a manner more and more costly.

It follows that in cases where a weaker current is to be obtained, it will be well to choose the strength of the alkaline solution in such a manner that this concentration should be in proportion to the strength of the current.

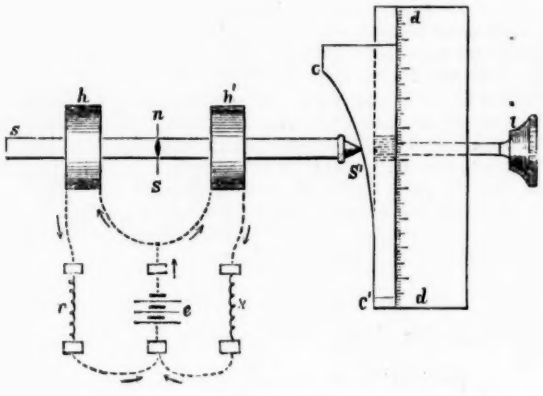



FIG. 1.

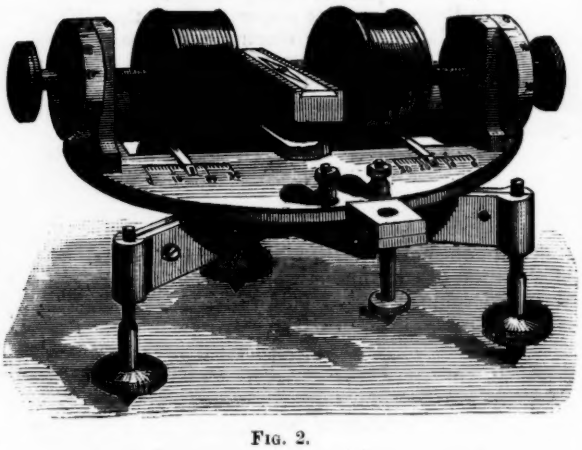


FIG. 2.

## MEASURING LOW RESISTANCES.

IN the fifth report of the Committee of Electrical Standards presented to the British Association at Dundee, September 4th, 1867, is found a very complete analysis of the conditions to be fulfilled in a practical apparatus intended for the measurement of resistances. They are summed up as follows: simplicity of construction, facility of manipulation, employment by an inexperienced operator with a degree of accuracy equal to that given by the Wheatstone Bridge method.

Our contemporary, *L'Electricien*, remarks that it was in order to satisfy these conditions that C. W. Siemens devised the apparatus to which he gave the name of *resistance measurer*, shown by the diagram, and by which one obtains—

1. The accuracy of the methods of reduction to zero;
2. Readings upon a single straight line divided into equal parts which represent equal units of resistance;
3. The employment of a single and invariable resistance of comparison.

Two equal and parallel bobbins, $b$, $b'$, are fixed upon a common guide, $s$, which can be moved longitudinally by means of an agate point, $s'$, a metallic curve, $c$, $c'$, upon which it rests, and of a milled head, $i$, which allows the curve to be moved vertically by the aid of a rack; $r$ is the fixed standard resistance, $x$ the resistance to be measured, $n$, $s$, a magnetised needle which is brought back to zero in each measurement. If $x = r$, and the magnetic actions of the two bobbins be rigorously equal and in contrary directions, the needle will be at zero when it is in the centre of the space which separates them. But if $x$ is greater or less than $r$ the equilibrium will be disturbed, and, in order to re-establish it, it will be necessary to move the bobbins, and bring that in which the current is weakest nearer to and that in which it is strongest further from the needle.

The curve may be constructed by making use of the formulæ given by Weber for calculating the action of circular currents upon a magnetised needle. In practice, C. W. Siemens prefers to construct this curve empirically by comparison.

The apparatus which M. Maiche presented recently to the Société Internationale des Electriciens may be regarded as a simplification and perfection of the Siemens instrument, with which it is identical in principle. In the apparatus of M. Maiche the two bobbins are not rigidly connected together, but may be moved independently of each other, and the fixed resistance, $r$, is suppressed, as well as the guiding curve.

The movable helices are mounted upon micrometer screws, each turn of which corresponds with a movement of 1 millimetre; a wheel, divided into 100 degrees, is fixed to the screw, and consequently turns with it before a vernier, of which the zero serves as the starting point. The slightest displacements of each of the bobbins are thus easily indicated.

With a single Daniell element, the apparatus was sensitive enough to clearly indicate a displacement of a quarter of a degree.

The value of displacement of the helices is calculated according to a standard resistance, and regulated so that each degree corresponds to $\frac{1}{1000}$ ohm. A half degree gives $\frac{1}{2000}$ ohm. The manipulation of this instrument is extremely simple, and the indications are very rapid.

## EBEL'S CURRENT MEASURER.

IN the following diagram (fig. 2), $n'$ $s'$ is a horse-shoe electro-magnet; $s$ is a single electro-magnet with one core; $a$ is a semi-circular armature of soft iron joined to a plate of non-magnetic metal, $b$, the latter being so formed as to equalise the balance of the armature, $a$, in its centre, $x$.

The electro-magnets, $n'$ $s'$ and $s$, are so placed that the extremities of their poles lie approximately in a circular line, allowing the armature, $a$, to move freely on its axis. The coils of $n'$ $s'$ are connected parallel with the coil of $s$ (but they can also be arranged in series), the latter coil, $s$, being provided with a cut-out.

The action of the instrument is very simple. The current to be measured passes through the coils of $n'$ and $s'$, producing strong magnetism in the poles and influencing the armature, $a$, in a certain pre-determined position, which will be according to the magnetic line.

or axis. This zero position is indicated by the pointer, $p$, fixed to $b$, as shown in the diagram. By inserting the electro-magnet, $s$, which, according to the connections in the diagram should produce the same polarity as $s'$, an instantaneous change is produced in the magnetic line, in consequence of which the $s$ and $s'$ poles influence the armature, $a$, conjointly and in opposition to the single pole, $n'$.

It follows that the pointer, $p$, will be moved to the right and will record on the scale the strength of the current. For example, assuming the relative positions

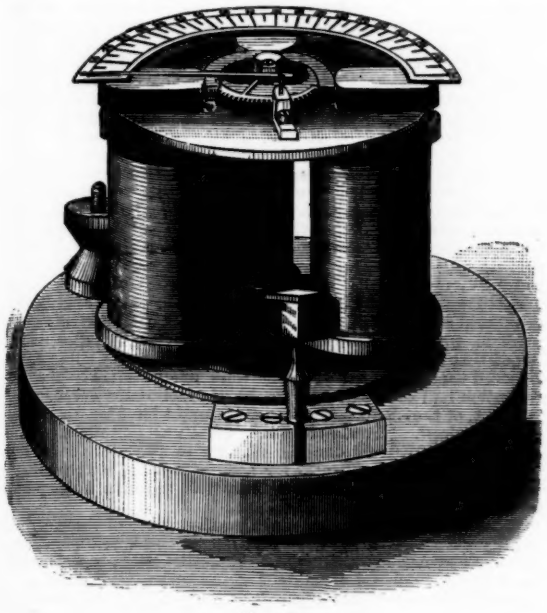


FIG. 1.

of the electro-magnets, $n'$ $s'$ and $s$, to form an equilateral triangle, and such electro-magnets to be so constructed as to exercise a controlling power of equal value, it would follow that the armature, $a$, would not be at all affected by any rise or fall in the potential of the actuating current but would remain motionless. But the electro-magnets being so constructed, relatively, as to exercise a differential influence, an effective ratio being arranged, it would ensue that the instrument would indicate the slightest variations in the strength of the current with striking exactitude.

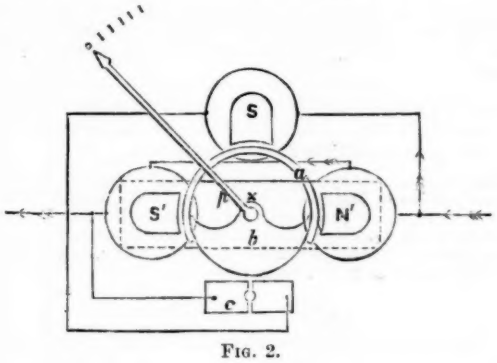



FIG. 2.

To provide a wider range of scale a light wheel gearing is arranged with the complete instrument.

Important improvements and special advantages are claimed for the invention. In the first place it is remarkably simple in construction, and also in application. The measurements are indicated instantaneously and with perfect accuracy, whether directed in a continuous or in an alternate manner.

We are assured that the instrument is not at all affected by any external influence, and may be used in any position whatever. It is entirely independent of any controlling power, such as spiral or other springs, weight, or permanent magnets which are well known to be subject to variation, and, further, it is free from movable electric connections under which conditions mercury is sometimes employed.

Finally, owing to its extreme simplicity the instrument is of very small dimensions and can be made up in a very neat and compact manner.

## GRUNDY'S LAMP HOLDER.

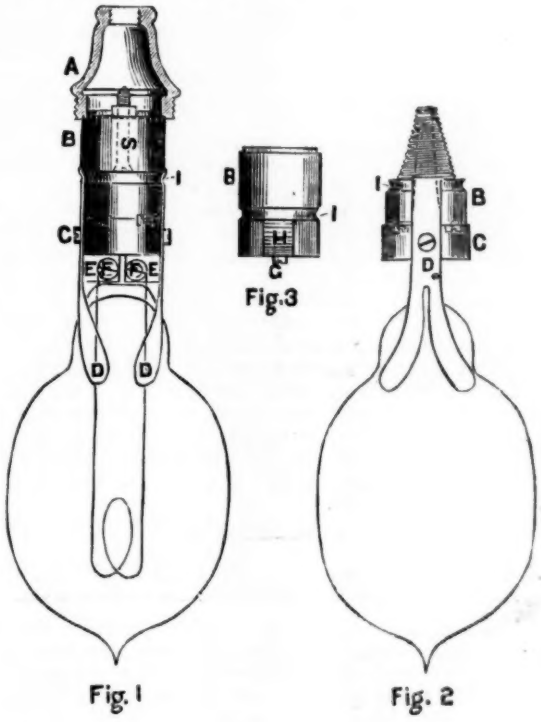
WE have recently described and illustrated several forms of incandescent lamp holders which have been more or less in general use, and we now furnish our readers with an illustrated description of an apparatus which we are informed is fitted in the Royal Courts of Justice.

Fig. 1 is the lamp holder as fitted at the Royal Courts.

Fig. 2 is the same adapted to screw into an ordinary gas or other tube.

Fig. 3 is the upper part of the holder, showing the electrical connections, which are identical in both cases. The insulating parts are different, in that, as the upper part of fig. 1 is fixed to its socket by a screw through the centre, there are two separate holes for the leads, while in fig. 2, as it has to be screwed into the pendant or bracket, both leads must come through one hole in the centre to prevent their being twisted.

A is a gun-metal nozzle, which is in use in the original fittings at the Law Courts, and for which these holders were first designed; this nozzle terminates the pendant, tubular or flexible. If flexible, the space of the tube is occupied by a fibre, or other insulating plug, with two holes for the wires.




The leads pass through two holes in the part B, and are secured by the binding screws, G, in fig. 3, thus ensuring a good contact between the leads and the parts, H, which extend up the sides of the part B as far as the groove, I. S is the screw which secures B to A. The plates, H, one on either side of B, now represent + and — of the circuit, and this part remains a portion of the electrolier, or pendant.

Part C is movable, and consists of an insulating block with two metal arms, D, D, spread out in a fan shape, so as to partially encircle the neck of the lamp,

and terminating at the other extremity in a collar made to fit the groove, I, in part B; the lamp is connected to these arms by the block, E, being pinched between the two parts of E, E, which are split, by means of the screws, F, F, thus ensuring a perfect contact and great rigidity in the lamp.

There is no danger of fusing either lamp lugs or holder contacts, as the lamp can be adjusted to the part C at leisure, and put up in one second when required. The lamp is first put up, and afterwards connected to the circuit by giving the part C a quarter of a turn, thus enabling the holder to be used as a switch wherever the lamp is within reach, and, when used for this purpose, a stop is added to prevent overturning the holder.

The whole of the contacts are in sight, and if used in a damp place, or anywhere where oxidization can take place, they are easily cleaned; in fact, the rubbing of the surfaces together in switching on and off will have a cleaning effect on the contacts.

## REVIEWS.

*The Quadruplex.* By W. MAVER, jun., and M. M. DAVIS, with chapters on The Dynamo-Electric Machine in Relation to the Quadruplex; The Practical Working of the Quadruplex Telegraph Repeaters, and the Wheatstone Automatic Telegraph. New York: W. J. Johnston, 9, Murray Street.

This work is of more value to American than to English readers, though there are no doubt many of the latter to whom the information given may prove of interest. It is a somewhat remarkable fact that the older form of quadruplex apparatus, which did not practically prove successful, and which was superseded by instruments specially devised to get rid of certain defects which presented themselves, is to some extent being reintroduced, and with good results; thus the ingenious compound relay of Gerritt Smith, which superseded the non-polarised relay, is being supplanted by the latter. In this country the use of pole-changers and duplex transmitters is gradually being abandoned, as it is found that direct working by keys is perfectly practicable; for repeating purposes, however, the pole-changer, &c., is, of course, still required. An improved form of non-polarised relay, employed by the Postal Department, is found to give excellent results. The chapter on "The Quadruplex," relating to "The Dynamo-Electric Machine in Relation to the Quadruplex," is interesting and suggestive. The description of the Wheatstone automatic apparatus will no doubt prove useful to American readers, since this method of working seems to be finding favour in the States. Speaking generally, we may say that Messrs. Maver and Davis's work has little which calls for criticism, while it has much to commend it.

*A Collection of Examples on Heat and Electricity.* By H. H. TURNER, B.A. London: Macmillan & Co.

The difficulty of setting suitable questions for an examination cannot be realised by those who have not undertaken such a class of work. It may appear at first sight to be quite an easy matter to set questions, but let those who think so try their hand, and they will soon find innumerable difficulties arise. Collections of examples are very useful, not only for their own intrinsic value, but also for their suggestiveness. We are decidedly of opinion, however, that such examples are of but very little use, unless they are accompanied by a key which gives not only the answers, but the way to work them out; this is especially necessary in the case of a work like that before us. The examples furnished, we may remark, are far above the ability of an average student, and would only prove useful to a limited class.

## ELECTRIC LIGHTING FOR STEAMSHIPS.*

By ANDREW JAMIESON, Assoc. M. Inst. C.E. and F.R.S.E.

### DISCUSSION.

(*Continued from page* 263.)

Mr. FRANK WYNNE referred to the statement in the paper that the expense of the maintenance of electric lighting was not much in excess of the older methods of illumination. That was a point upon which it was very difficult to get satisfactory information. The estimates received of the cost of the earlier methods varied from 100 to 150 per cent. Those variations not only applied to ship lighting, but also to railway lighting. He had hoped that the author would have been able to give some trustworthy details on the subject. With regard to driving by iron gearing, he might mention that in the case of a Mexican ship fitted with machines it was found to answer very well. No doubt, however, it was a severe trial to a machine to be driven by cast-iron gearing, to say nothing of the noise; and when there was an excellent system like that introduced by Messrs. Siemens Bros., known as the Raworth gearing, he did not know why it was not more generally adopted. It had been suggested, and he thought that the suggestion was a very practical one, that the driving-wheel should be the soft surface, and not the driven wheel. That seemed very rational, because otherwise there was a danger of a facet being cut upon the driven wheel. Mr. Wynne was in favour of direct-driving machines. That was the best method for quick speed, but the company with which he was connected had systematically adopted low-speed dynamos, as getting over all the difficulties connected with shafting and belting. He had expected to hear more as to what had been done with driving by ropes, and he hoped that the author would say something on the subject. He believed that low-speed dynamos were unquestionably the best. Attention had been directed to the characteristic curve, nearly straight, of the Victoria dynamo. It might have been made perfectly straight. The electromotive force was permitted to drop slightly as the current diminished, both to allow for the decrease of loss in the leads, and also for any momentary acceleration of speed in the engine where suddenly relieved of a large portion of its load.

Mr. J. FARQUHARSON observed that the author of the paper had made some reference to what was being done on board men-of-war; and as he knew more about those ships than about merchantmen, he might be allowed to state that the author was rather in advance of the actual state of the case in saying that no man-of-war now left the builder's hands without being lighted electrically. There were but three fighting ships in England so lighted. The first lighted by the incandescent system was the Brazilian iron-clad *Riachuelo*, and since then two other ships in the navy had been fitted, the *Polyphemus* and the *Colossus*. A great many transports and troop-ships had been lighted, and he was able to give some particulars of the results obtained in one or two of them. During the last year and a half five large Indian troop-ships, the *Malabar*, *Crocodile*, *Serapis*, *Jumna*, and *Euphrates*, had been lighted, and the imperial troop-ship *Orontes*. The five large troop-ships had an installation of about 400 lamps each, and he had some particulars of the cost of two of them, which had been carefully prepared with a view of showing how the cost compared with that of ordinary lighting. Before reading the statement, he might remind the members that it ought not to be assumed that the cost of lighting ships in the Royal Navy by the ordinary system was fairly comparable with the cost of lighting other ships. No mineral oil, for example, was allowed in ships of the Royal Navy, and the colza and olive oil used in them was more costly, so that the comparison would not be the same as that with private ships.

*Details of the Cost of Lighting H.M. Indian Troopship "Crododile," for Ninety Days, by the Old and New Systems, viz., Candles and Oil, and Electricity by Incandescent Lamps.*

The number of lamps by each system was about the same. The actual number of incandescent lamps was 438. They were of two sizes, viz. 10 candle-power 307, and 16 candle-power 131. It would be seen by the details of cost that the bulk of the ordinary lamps were candles, and the proportion of light would therefore be electrically greater as 10 to 1 or thereabout.

*Details of Expenditure.*

NEW SYSTEM.—Incandescent Lamps. Details of Material.

| | £ | s. | d. |
|---|---|---|---|
| Coals, 112½ tons at 15s. per ton ... ... ... ... | 84 | 7 | 6 |
| Cotton waste, 90 lbs. at 27s. per cwt. ... ... ... | 1 | 1 | 8 |
| Oil (mineral), 180 gallons at 1s. 2d. per gallon ... | 10 | 10 | 0 |
| ,, (olive), 23 gallons at 3s. per gallon ... ... ... | 3 | 9 | 0 |
| Lamps replaced, 35 at 3s. 6d. each ... ... ... | 6 | 2 | 6 |
| Lamp globes, 15 at 3s. each ... ... ... ... | 2 | 5 | 0 |
| Fusible wire plugs, at ¼d. ... ... ... ... | 0 | 1 | 8 |
| Depreciation on plant, at 2½ per cent. ... ... ... | 12 | 0 | 0 |
| Total ... ... ... ... | 119 | 17 | 4 |

* From the Proceedings of the Institution of Civil Engineers.

OLD SYSTEM.—Candles and Oil. Details of Material.

| | £ | s. | d. |
|---|---|---|---|
| Candles, Stearine, 250 lbs. at 32s. 4d. per 50 lbs. ... | 8 | 1 | 8 |
| „ police lamps, 1,300 lbs. at 32s. 4d. per 50 lbs. | 42 | 0 | 8 |
| „ fighting lamps, 1,750 lbs. at 34s. per 50 lbs. ... | 59 | 10 | 0 |
| „ signal, 1,430 lbs. at 34s. per 50 lbs. ... ... | 48 | 12 | 0 |
| Oil, colza, 493 gallons at 2s. 3d. per gallon ... ... | 55 | 9 | 3 |
| Wicks, cotton, 160 at 1½d. per doz. ... ... ... | 0 | 1 | 10½ |
| Cotton balls, 8 lbs. at 8½d. each ... ... ... ... | 0 | 5 | 8 |
| Chimneys ... ... ... ... ... ... ... | 0 | 4 | 0 |
| Depreciation of plant, at 2½ per cent. ... ... ... | 3 | 14 | 0 |
| | 217 | 19 | 1½ |
| Abate value of cases returned ... ... ... ... | 4 | 14 | 0 |
| | 213 | 5 | 1½ |
| Total cost of new system ... ... ... ... ... | 119 | 17 | 4 |
| Difference in favour of electricity ... ... ... | 93 | 7 | 9½ |

Or £377 per annum.

The labour on the two systems was practically the same.

The statement took no account of labour by the old or by the new system, the fact being that no additional labour was allowed. Two engine-room officers were told off to attend to the dynamos and the incandescent lamps, and since as many lamp-trimmers would be employed on the old system, the cost for labour would be approximately the same.

He had received the subjoined return relative to the electric lighting of H.M.S. *Malabar*, from which it would be seen that it was possible to make lamps that would last more than 6,000 hours.

Summary—Failure of the fibre... 46 } Total from actual
Collapsed ... ... 10 } use, 56
Accidental ... ... 33
Softening of plaster... 75

The mean life of the 56 lamps broken in actual use was 2,063 hours. The cost of the lamps, exclusive of the 75 which failed from a defect in manufacture, which defect had since been remedied, viz., 89 at 5s. (being the increased price now charged for them), was £22 5s., or £44 10s. for the whole year on an installation of 384 lamps.

An allowance had been made of 2½ per cent. for deterioration of plant by both systems of lighting. The choice of position for dynamos, so far as ships of the Royal Navy were concerned, was limited. There were no unappropriated spaces in a man-of-war, and the question of lighting had not been considered when the ships were built. There was a choice of two or three places, none of them being very good; but it had never been necessary to put the dynamos athwart ships, and so far, with very few exceptions, there had been very little injury to the dynamo from gyrostatic action. He did not know what the author's object was in his statement with regard to the selection of dynamos; but if intended for the guidance of those who knew nothing about them, the better way would be to specify distinctly the work to be done, and the conditions under which it was to be done, with the limits of weight and size. The author had stated that dynamos underwent an insulation test of 10,000 ohms per volt generated. It was certainly not expected to get anything of that kind in the ships of the Navy. After a dynamo had been running for some hours in the vapour of steam, and in a generally moist condition, it was considered satisfactory if no blue

*Number of Hours Electric Lamps have been Burning in the different Circuits on H.M.S. "Malabar," and the Number of Lamps which failed in each from various Causes, from August 6th, 1883, to October 31st, 1884.*

| Circuits. | Number of lamps in circuit. | Number of hours. | Lamps broken from the undermentioned causes. | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Plaster soft. | Fibre broken. | Accidental. | Collapsed. | Total. | |
| Saloon deck aft, day ... | 54 | 1,736 | 1 | 6 | 2 | 2 | 11 | The average life of the 130 lamps which failed from breaking of fibre, or collapsing, was 3,799 hours each: the shortest life being 638½ hours for eight yard-arm lamps of 32 C.P. |
| „ „ „ police ... | 19 | 3,950½ | ... | 4 and 1 (32 C.P.) | 1 | ... | 6 | |
| „ „ forward, day ... | 30 | 1,030½ | 1 | 3 | ... | ... | 4 | |
| „ „ „ police | 27 | 3,912 | 4 | 23 | 9 | ... | 36 | |
| Main deck aft, day... ... | 28 | 1,769½ | 1 | ... | ... | ... | 1 | |
| „ „ „ police ... | 6 | 4,506 | ... | 4 | 1 | ... | 5 | |
| „ „ forward, day ... | 86 | 901 | 65 | 8 | 14 | 1 | 88 | |
| „ „ „ police | 17 | 3,953 | 9 | 5 | 3 | ... | 17 | |
| Lower deck aft, day ... | 25 | 1,733 | ... | 1 | 1 | ... | 2 | |
| „ „ „ police ... | 6 | 5,763 | ... | 3 | ... | ... | 3 | |
| „ „ forward, day ... | 34 | 791½ | 17 | 13 | 3 | 1 | 34 | |
| „ „ „ police | 5 | 3,820 | 4 | 4 | 1 | ... | 9 | |
| Engine room ... ... | 37 | 6,322 | 16 | 29 | 19 | 10 and 2 (32 C.P.) | 76 | |
| Store rooms ... ... ... | 10 | 5,793½ | 1 | 2 | 1 | ... | 4 | |
| Starboard yard-arm ... | 8 of 32 C.P. | 638½ | ... | 7 (32 C.P.) | 2 (32 C.P.) | 1 (32 C.P.) | 10 | |
| Port yard-arm ... ... | 8 of 32 C.P. | 316½ | ... | ... | 6 (32 C.P.) | ... | 6 | |
| Broken in lamp room ... | ... | ... | ... | ... | 4 | ... | 4 | |
| Total ... ... | 400 | ... | 119 | 113 | 67 | 17 | 316 | |

He had also another return which he thought would be interesting to the members.

Number of incandescent lamps worn out from various causes, and replaced in H.M. Indian Troop-ship *Malabar* between the 6th August, 1883, and 16th February, 1884, viz., 183 days; and the number of hours each lamp had been burning; the total number of lamps in the installation being 384.

| Number of Hours Burnt. | Cause of Failure | | | | |
|---|---|---|---|---|---|
| | Plaster Softened. | Fibre Broken. | Collapsed. | Accidental. | Total. |
| 488 | 12 | 11 | 1 | 2 | 26 |
| 543 | 40 | 2 | 1 | 5 | 48 |
| 613 | 1 | 1 | ... | ... | 2 |
| 995 | ... | ... | ... | 1 | 1 |
| 1,019 | 1 | 3 | 2 | 2 | 8 |
| 1,042 | 1 | ... | ... | ... | 1 |
| 2,193 | 1 | 3 | ... | 1 | 5 |
| 2,226 | 6 | 2 | ... | 3 | 11 |
| 2,254 | 4 | 13 | ... | 6 | 23 |
| 2,259 | ... | ... | ... | 1 | 1 |
| 2,431 | ... | ... | ... | 1 | 1 |
| 2,994 | ... | 1 | ... | ... | 1 |
| 3,558 | 1 | 1 | ... | ... | 2 |
| 3,698 | 8 | 9 | 6 | 11 | 34 |
| Total . . | 75 | 46 | 10 | 33 | 164 |

sparks could be got in the dark by taking a wire from one of the brushes to the frame of the machine, the frame of the machine being connected with the ship. So far there had been no failure in a single instance. With reference to the speed of the dynamo in the navy, gearing of every description was avoided, all the dynamos being driven direct. In former years some of the dynamos were driven by gearing, but the practice had been entirely discontinued. It was now considered that the proper speed of a dynamo was that which would secure a lasting and economical engine, and with that view it was thought that for dynamos which might be expected to have a load of from 16 to 18 H.P. 400 revolutions was a good speed, and there was no difficulty in obtaining good engines to work at that speed. The result, judged by the amount of work done by the power absorbed, would be the same with that or a higher number of revolutions per minute, but the cost was necessarily more; and it might be taken that the cost of a low-speed dynamo was increased about 40 per cent. Comparing it with a dynamo running at 1,000 revolutions doing the same work, 40 per cent. more would have to be paid.

As to the governing of an engine, no difficulty had been experienced. He was not aware of the failure of a single lamp from extra stress put upon it through the increased speed when the load was lightened. It had been stipulated that the system should be capable of allowing 90 per cent. of the lamps being turned out without any extra strain being put on the remainder. That was one of the tests applied to ascertain whether the stipulation in the contract had been kept, and there had been no difficulty in accomplishing it. The speed of the engine, when all, or nearly all, the lights were taken off, was somewhat increased, but well within the limit given by the author. The engines were governed sufficiently at that low speed so as not to exceed 25 revolutions more for a moment than with the whole load. He

thought, therefore, that electric governors were unnecessary. In the Navy, ships were wired on the double system, with one exception, but he knew no good reason why it should be adopted. Electricians were asked to believe, without any reason, that it was easier in the one case to connect the wire with the skin of the ship than in the other to connect the two wires. He had never been able to learn that the work by the one system was more liable to derangement than by the other. The Admiralty had a ship wired on the three-wire system, and it had turned out to be the worst of all. He might mention what happened in practice. After coaling, the hose was turned on, and leakage took place in the casings, and water lodged in the grooves, which soon destroyed the dielectric, forming, as the author had described, sub-chloride of copper, and soon corroding the wire. Surely two wires were more liable to injury of that kind than one wire. Government had spared neither money nor time in trying to avoid that leakage, but had not entirely succeeded in a single instance. They were now about to do something in the hope of preventing it, namely, to sink the grooves one and a half time the diameter of the wire, completely filling in the groove with a composition of 80 parts of common putty, and 20 of white lead. That did not shrink or crack much, and it would at any rate have the effect of preventing the lodgment of water, whether with the one-wire system or the two wire system. If by any means the water could be kept out, more would yet be accomplished. With reference to fusible cut-outs, he was glad to hear that Mr. Swan advocated tin wires; but the author appeared to be under the impression that cut-outs were needed for a purpose not at all contemplated in the Navy, namely, the saving of the lamps. By a properly-balanced compound-wound machine, no trouble was experienced in that respect. In the event of a nail being driven in to hang the cook's ladle upon, unless there was a cut-out in the branch the wire would be heated, which might ignite the casing. The cut-outs were for the purpose of opening a circuit in case of its being shortened. A cut-out was put in every main, in every sub-main, and in every branch to prevent extra heat and ignition from an accidental cause. He should like to know from the author whether he should expect that lamps burning with small currents in a high state of incandescence would last relatively as long as those burned in a lower state of incandescence. He had had very little experience with it, but he believed that the nominal candle-power in the ships of the Navy was well maintained.

Mr. J. G. MAIR asked Mr. Farquharson what type of governor gave such a remarkable result, as to allow the shutting-off of 90 per cent. of the lighting with so small a variation of speed?

Mr. FARQUHARSON said it was not the question of a governor, but of a dynamo and governor. The engine generally used was a Brotherhood; it had done good service and borne a great deal of hard wear. In the *Himalaya*, the dynamo and engine had been running almost constantly for two years, and had cost scarcely anything. The dynamos were Siemens alternating, the only case they had of alternating dynamos. The men-of-war were peculiarly situated as to the kind of dynamo used, because the dynamos were required to do two things, to be able to give a search light of 25,000 candles, and to light a certain number of incandescent lamps when not wanted for that purpose. In all the fighting-ships using the search-lights there were direct-current dynamos. The dynamos in the *Himalaya* had an exciter, which was of the Siemens S.D. type. It had been running constantly for two years, and had not had any repairs done to the commutator, which might be considered very good wear.

Mr. ALEXANDER SIEMENS wished to say a few words as to the curve of the compound machine. It was not a good specimen of a self-regulating machine, no account having been taken of the resistance of the leads. To make this evident, let it be supposed that a current of 100 ampères had to traverse leads, having the resistance of $\frac{1}{10}$ ohm before reaching the lamps. In this case the difference of potential at the terminals of the machine must be 10 volts greater than the difference of potential at the terminals of the lamps. Again, if a current of only 1 ampère was to traverse the same leads, the difference of potential at the terminals of the machine need only be $\frac{1}{10}$ volt greater than at the lamps. A good self-regulating machine should, therefore, give a greater electromotive force when the current increased, the ratio of the increase depending on the resistance of the leads and the maximum current.

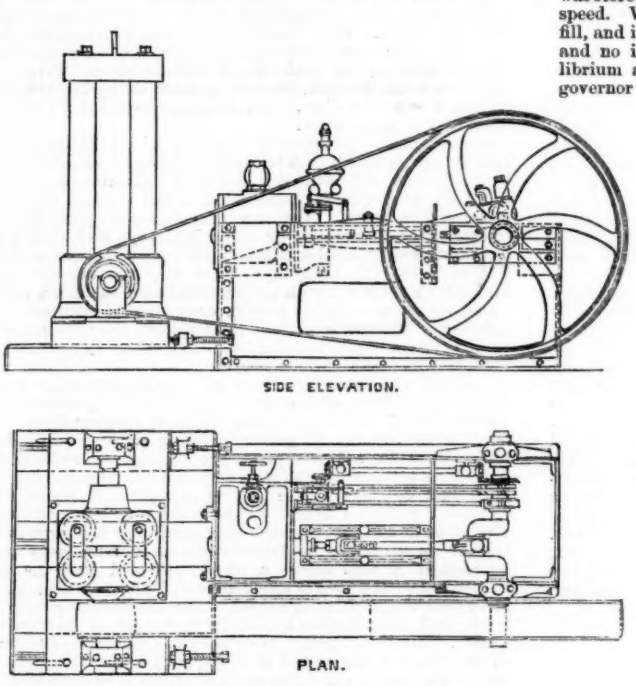
With reference to the lighting of the *Aurania*, Mr. Preece had complained first, that the pressure of the mains was not equal in all parts of the ships. To a certain extent that was true on the single-wire system. The lamps nearer the machine would have a little less resistance in circuit than those further off; but seeing that the resistance of the main was so small that difference of potential could be neglected. But had Mr. Preece taken into account that unavoidably the lamps were not absolutely equal? Lamps of 20-candle power of nominally 100 volts would require from 98 to 102 volts, a greater difference than that caused by the resistance of the wires, so that when lamps burnt a little less brightly in one part of the ship than in another, it was probably more the fault of the steward than of anybody else. He was sorry Mr. Preece had complained of the joints, and he would take care to have the matter looked into. The chandeliers in the saloon had not been supplied by Messrs. Siemens Bros., and additional lights had been put up by the owners since the installation had been handed over to them.

He thought the paper, and a good deal of the discussion, had been rather too theoretical. The author had begun with a short statement of the advantages of electric lighting on board ships, but he had left out the greatest advantage: that it was now possible, for the first time, for marine engineers to see the engines working; and they appreciated this, as proved by the lights on board the *Aurania* having been at work in the engine room from the time of the ship's leaving Liverpool until her arrival at New York. With reference to the requirements of dynamos and steam engines for a ship's installation, the author had stated the theoretical requirements, but not the practical ones, viz., that the dynamos and steam engines should both be constructed for rough usage, and should be capable of being easily repaired even at sea, by ship's engineers, and that above all they should be amply powerful for their work. A dynamo which was supplied for 200 lamps regularly, ought to be able at a stretch to light at least 220 without being damaged in any way, and the author and other engineers would confer a great benefit on electric lighting if they rigorously required contractors to supply large engines and large dynamos. He thought it would be unwise to give up putting a fuse to every lamp; if a fuse were only put to a group of lamps, and an accident happened to one lamp, the whole group would go out, and the engineer would have to hunt over 12 circuits instead of over one to find out the defect. That was also a practical consideration. Reference had been made to the disadvantage of the single-wire system. One of those disadvantages was stated to be, that if salt water got in chloride of copper would be formed, and the lead destroyed, but he begged to submit that that applied as much to the double-wire system, because no dynamo machine was ever so completely insulated from the ship that there was no leakage. Mr. Farquharson had pointed out how close together the two wires necessarily were, because there was so little head room, and many other things had to be accommodated. In the case of Her Majesty's ships, and sometimes in the case of ordinary ships, Mr. Farquharson's remarks, that in the single-wire system the wire was near the skin of the ship, would be applicable; but in general it was not, as the wire was on the average 18 inches from the skin of the ship. In a passenger steamer the iron beams were covered with wood; there were panels of wood everywhere, and if anyone had injured the insulation of the single main he would have some difficulty in finding the skin of the ship to make a short circuit. In every ship, when it was wanted to make the connection from the lamp to the ship's skin, a considerable distance had to be traversed. He therefore thought that the danger to the single-wire system was entirely theoretical, and that that system was much safer than the double-wire method, where the two wires being closer together could easily be short circuited. Then there was not half the resistance in the single-wire system, because the skin of the ship being of very large extent had virtually no resistance. That meant that if in the one case 10 per cent. of the power was lost, in the other it would be only 5 per cent., and from a scientific point of view all waste ought to be avoided. Another point, not mentioned in the paper, was the desirability of working the small auxiliary motors on board ship by means of electricity, as there was much trouble with the steam pipes which led from the boilers to the steam engines. This would be entirely avoided if their place was taken by the leads to the electrical machines.

Mr. KILLINGWORTH W. HEDGES had recently examined the action of the electric lighting machinery on board ship, during a voyage to New York and back, which he had made in two steamships of the same line. Each was fitted with apparatus, supposed to have all the most recent improvements. One of them had an alternating current machine with an exciter on the same shaft, and the other a compound-wound machine. The alternating current machine gave considerable trouble, but the compound-wound was more satisfactory. During both the outward and homeward trips the lights were worked perfectly, and there was no breakdown nor hitch. He made careful inquiries as to how they behaved on former voyages. The drawback of the alternating-current machines seemed to be chiefly due to the large size of the armature. When there was any play in the bearings, the armature had a tendency to touch one side or the other, and although probably actual contact was hardly made, some of the coils were burnt. The machine was placed in the ship in the manner advocated by the author, fore and aft, but the compound-wound machine was put across the ship. Another fault common to both machines was the deficiency of the lubricating arrangements. As the machines were placed on board they had the ordinary oil-cups and oil-holes in the centre. When the ship heeled over, the oil could not get to the top part of the bearings, and there was a difficulty in keeping them lubricated, especially if there was a wind on one side maintaining the ship at an angle for some time; so that other oil-holes had to be drilled. A simple remedy would be to have a wick underneath, and to put the oil in a cup, something like what was done in the case of railway axles, so that the oil would be sucked up and spread over the shaft equally. The dynamos were driven by rope-gear, which seemed to work well. That also gave trouble at first, but the principal difficulty of keeping it dry was overcome by coating it with black lead and tallow. Rope-gearing ought to be boxed in, as there had been a bad accident on the previous voyage from a man getting entangled by the rope. No matter what driving gear was employed, he thought that it was better for all ships to have direct-acting engines for electric lighting. He had put a direct-acting engine for the electric light installation on the *Chimborazo* in 1880, and it had been in use ever since. The author had referred to the most economical section of conductor to be used, and stated that he found 1,000 amperes per square inch of section to be the best. That did not seem to agree with practical working, at any rate in the United States; the Edison Company for house to house lighting in New York used a much higher rate. On the

new system employed there, on cables carrying 100 or 110 amperes there were 5,000 amperes per square inch, and in the Edison two-wire system 3,400 amperes were used. The reason seemed to be that to get the best economy out of copper cable, it should be worked all day; and in order to compensate for the time when it was not being worked, and for the time when the current passing through was only equal to a few lights, it had to be worked at a rather greater current for a certain period when all the lights were on. If the insulation was good there was no objection to this plan. The author had mentioned a case were fifty lamps were destroyed by the governor getting out of order. Mr. Hedges had investigated that case, and ascertained that none of the fuses were melted. If they had been put in to save the lamps, there was no reason why the harm done should have been more than the melting of a few of the fuses. Of course, there was the trouble of putting out the lights, but that was better than the large expense entailed. He used an apparatus which inserted a duplicate fuse automatically; the arrangement was designed to put in a second fuse, and so prevent the extinction of the lights, unless a short circuit occurred, when both would be melted.

Mr. J. N. PAXMAN said that, although it could not be denied that there were advantages in high speed engines for certain special purposes, up to the present they had not been able to compete with those of lower speed either in economy or durability. On board ship, where the stoppage of machinery was at times attended with great danger to the vessel, durability and efficiency were of the first importance: repairs also were always more difficult and costly. The sacrifice of space was but small with engines




FIGS. 8 AND 9.—COMBINED STEAM-ENGINE AND DYNAMO.

and dynamos combined, as would be seen in figs. 8 and 9. The firm of Davey, Paxman, and Co., had made several of this type; and an engine, together with the dynamo sufficiently large enough for driving comfortably two hundred lights, would only occupy a space of 12 feet by 4 feet. When it was considered that the machinery was all visible to the attending engineer; also that such engines were easy of access, and could be run for a week if necessary without stopping, these advantages were more than a set-off to the trifling additional space required. It would be noticed that the figs. represented a horizontal engine, mounted upon a wrought-iron box frame forming the foundation, so as to combine lightness and strength. The cylinder was 12 inches in diameter by 12 inches length of stroke, and the engine ran at 180 revolutions per minute. All the parts were balanced. This engine was fitted with Paxman's automatic cut-off gear, and the governors were driven with tooth-gearing, and they would regulate the speed within 2 per cent. with all the load on or off. The dynamo attached to the engine-framing was driven from the fly-wheel with a leather belt 9 inches wide. The dynamo could be readily adjusted to keep the belt tight whilst running. Fig. 10 represented an arrangement proposed for driving a dynamo with compound friction-roller gear. A was the flywheel of a vertical engine; B was the friction pulley on the dynamo; C C were two friction wheels lined with stout India rubber tightly forced on, or vulcanited upon the pulleys. These impinged upon the flywheel and dynamo pulley, one upon the top and the other below. By this means a double grip was obtained, and the liability to slip was lessened by half. By this method the force exerted upon the armature of the dynamo by these two wheels was nearly opposite, thus relieving it of excessive side pressure. He desired to come to the rescue of the mechanical governor, which had received very sharp criticism from the author, and from speakers in the course of the discussion. Two or three leading principles should be taken into account in making a governor, and they were very simple. At the Exhibition held at South Kensington, in 1884, a governor worked practically true, regulating the speed of the engine within 1 or 1½ per cent. In stating that, in low speed engines, the governors would not run within 5 per cent., and in high speed engines 25 per cent., he thought the author must have fallen amongst an indifferent set, for it was not an uncommon thing to have a governor regulating the speed within 2 per cent. He had the particulars of some trials in May, 1883, which he thought might be of interest to the members. He had that day received some particulars of a trial of a small single-cylinder engine, where the governor ran within 1½ per cent., all the load being on and then immediately taken off. He had been told that that was sufficiently regular for driving electrical apparatus. In the case of the compound-wound dynamo, he was informed that it did not matter so much about diminishing the speed with a decreasing number of lamps. In making governors, the objects should be to have as little friction as possible, reducing it almost to nothing; and in the second place, there should be no reservoir for steam. He advocated automatic cut-off and govenors driven with gear, not with a belt. One of the chief disadvantages in the governor was that the slide-chests were generally rather large, and the throttle-valve at some little distance, so that there was a large reservoir of steam; and if the load was taken off, sufficient power was stored up to drive the engine several revolutions with increased speed. With automatic gear there were only the thoroughfares to fill, and immediately the steam was cut off there was no storage, and no increase of speed. The throttle-valve should be in equilibrium and a good fit, so as to prevent leakage. Again, the governor should be able to control the engine without an excessive

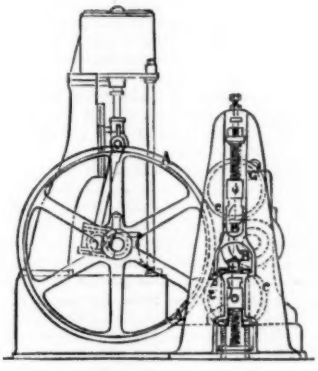


FIG. 10.

COMBINED STEAM-ENGINE AND DYNAMO.

movement of the balls. Keeping these objects in view, engines could be well regulated within 2 per cent. In conclusion he would ask if the author's electrical governor could be made to control the engine within 2 per cent., as certainly was done by the mechanical governor. Like the governor just mentioned, it could not anticipate the reduction of power, and therefore could only modify the speed of the engine after the power was increased or decreased.

*Test of Governors combined with Automatic Cut-off Valve for ascertaining Speed of Engine under various Pressures of Steam with and without Loads, by J. N. Paxman.*

60-H.P. Compound Engine, Cylinders 15 inches and 22½ inches, length of stroke, 24 inches. May, 1883.

| Test Number. | Steam Pressure. | Indicated H.P. with Load. | Number of Revolutions. | Indicated H.P. without Load. | Number of Revolutions. |
|---|---|---|---|---|---|
| | lbs. | | | | |
| 1 | 45 | 83·6 | 102·00 | 17·18 | 103·50 |
| 2 | 60 | 128·0 | 102·25 | 18·00 | 103·75 |
| 3 | 75 | 137·0 | 102·25 | 17·70 | 103·50 |
| 4 | 90 | 135·5 | 102·00 | 17·20 | 103·50 |
| 20-H.P. Double Cylinder, Semi portable Cylinders, diameter 10½ inches, stroke 14 inches. May, 1883 | | | | | |
| 1 | 40 | 32·0 | 138·00 | 11·5 | 140·0 |
| 2 | 50 | 40·9 | 138·00 | 10·0 | 139·5 |
| 3 | 60 | 47·7 | 138·50 | 10·4 | 140·0 |
| 4 | 70 | 66·0 | 138·75 | 11·2 | 140·5 |

Mr. PERCY SELLON remarked that attention had been particularly drawn to the curve of the compound-wound Victoria dynamo. Mr. Siemens had gone so far as to say that he would reject a dynamo from which such a curve had been obtained; but Mr. Sellon thought such a course would be uncalled for. The objection raised was, that no allowance had been made for fall of potential in the leads on the curve: the curve in question had been taken from a dynamo intended for ship-lighting, where the loss of potential in leads was necessarily small; and if the curve was examined, it would be seen that a drop of 2 volts of potential had been allowed for, representing 4 per cent. of the total electromotive force of the machine, and that, according to his experience, was what actually obtained in ship-lighting. He agreed with Mr. Siemens that, for ordinary purposes in installations on land, a large loss had to be allowed for, in many cases as much as 10 per cent.; and for that reason it was desirable to wind dynamos for the particular circuits on which they were intended to run. It had also been found in practice that a greater drop than would be accounted for by loss of potential in leads was necessary, to allow for the slight rise in the speed of engines as the load on them was lowered. A further point, and one which had been raised by Dr. John Hopkinson, was whether it was practicable to connect compound-wound dynamos in parallel. The general impression, after Dr. Hopkinson's remarks on that point, was, he believed, that it was not advisable to do so in practice, and that shunt machines were preferable for that purpose. It had been found, however, that if a third wire was carried, connecting up the series wires of two or more compound machines at the point were the series wires joined the armatures, so that the whole of the series wires might be considered to be in one parallel, a reversal of polarity of any one machine was, within considerable limits of speed, guarded against, and there was an equal distribution of current among the series coils. Dr. Hopkinson had mentioned that he had found that if one of a number of compound machines connected in parallel showed from any cause a higher electromotive force than the remainder, that particular dynamo would tend to build up current, and so to do the whole external work, to the exclusion of the other machines. Mr. Sellon had found, however, that connecting up machines in the manner stated obviated this difficulty within the limits required in actual working. Attention to such points as these had brought compound-wound machines to the pitch of perfection shown by the graphic curve of the Victoria dynamo; and taking in view the undisputed advantages of compound machines for both ship-lighting and ordinary purposes, it appeared obvious that they would be even more extensively used in the future than they had been up to the present. As representing one of the companies who had perhaps had as great an experience with storage batteries for ship-lighting as any, he might say that they had used them largely for manufacturing processes and internal lighting, and some had been in continuous operation longer than a year without material deterioration. For many purposes secondary batteries would be most useful in ship-lighting; for instance, the same dynamo which internally lighted the vessel might charge the accumulators, which would supply power ready to hand for motive power or propelling a steam-launch or torpedo-boat, and so save the time lost in getting up steam. He believed a demand for secondary batteries would create a supply of so satisfactory a nature as to ensure their very general adoption on board ship for motive power purposes; but he was unable to give any information with regard to the increased cost of lighting occasioned by the employment of secondary batteries.

(*To be continued.*)

## THE TELEPHONE AND TELEGRAPH COMMITTEE.

WITH a view to arriving at some settlement of the much-vexed question of the control of telegraph, telephone, and electric lighting wires, a Select Committee of the House of Commons has been appointed to deal with the subject, the gentlemen nominated being Mr. T. A. Dickson, Mr. Firth, Sir A. Gordon, Mr. E. D. Gray, Mr. Coleridge Kennard, Sir J. McGarel Hogg, Mr. G. Russell, Mr. Torrens, and Mr. Tottenham. The committee selected Mr. G. Russell, Parliamentary Secretary to the Local Government Board, to preside over them, and they have now entered with energy upon their inquiry.

Although the investigation bears more directly upon the position, rights, and privileges of telephone rather than telegraph wires, it was natural that the first evidence presented to the committee should come from the Post Office, that department at present exercising considerable control over telephones, as well as supreme authority over the home telegraphs. Accordingly, at the first sitting Mr. Robert Hunter, solicitor to the Post Office, gave evidence with special reference to the relative position and powers of the Post Office and private companies. He explained that the rights of the Post Office were defined by Acts of Parliament, the Act of 1868 having transferred the telegraphs to that department, and the Act of 1869, giving the Postmaster-General a monopoly of the telegraphs, but conferring no special powers with regard to the laying of wires. Up to 1878, it appears from his evidence that local road authorities possessed an absolute veto as to the fixing of overhead wires, but in that year another Act was passed, giving the Postmaster-General an appeal against such veto to the magistrates or the County Court, and a further appeal to the Royal Commissioners. At present the Post Office, when desiring to erect an overhead wire in a town, must obtain (1) the consent of the road authority; (2) the consent of the private persons upon whose buildings an attachment is proposed, or, if the line is a pole line, the consent of the occupier of every dwelling house within ten yards of a pole; and (3) besides this, in the country the consent of the persons owning and occupying parks and pleasure grounds along the route. With regard to attachments and the erection of posts within ten yards of a dwelling house, there is apparently no right of appeal from a refusal of a consent. These conditions have raised many difficulties in the way of the Post Office, and Mr. Hunter makes the following suggestions for simplifying the existing system: that there should be an appeal in every case, except as to attachments to private property; that the Postmaster-General should give proper notice of his desire to erect a line, and that all persons who have a *locus standi* under the Act of 1863 to veto or object—whether public authorities or the owners of property affected—should have an opportunity of sending in written objections, and that the case should then stand referred to some one tribunal having the power to deal with the matter once for all; that this tribunal should be the County Court, which has hitherto disposed of cases in a simple and inexpensive way; that the appeal to the Royal Commissioners should be abolished as unnecessary, and causing delay and expense; and that the provision requiring the consent of the occupier of every house, within ten yards of which a pole is to be erected, should be repealed, or that at least the distance should be reduced; the right of such occupiers to object with other persons interested in property along the route seeming to be sufficient protection. With regard to underground wires, Mr. Hunter does not consider any alteration in the law necessary, except as to abolishing the appeal to the Royal Commissioners. Private companies he would place in the same position as the Post Office in the matter of overhead wires. This much as to the Post Office and ordinary telegraph wires.

Turning next to the case of telephone wires, it seems from Mr. Hunter's explanation that telephone companies, as licensees of the Post Office, are not entitled to any of the statutory powers which the Postmaster-General possesses as to the erection and maintenance of telegraphs. They cannot interfere with public highways, or carry wires either over or under highways, and their position has been fixed by legal decisions upon several actions against the United Telephone Company. They may not interfere with a highway in order to lay an underground wire in such a way as to cause obstruction to the public, even though such obstruction exists only during the work of laying down the wire, either with or without the consent of the local authority. In towns the road authority is, under various statutes, the owner of the surface of the street, and any interference with such surface is a trespass; and both in town and country remedies are provided for the obstruction of highways within distances varying from 15 ft. to 30 ft. of the centre, and persons causing an obstruction beyond such distances may be proceeded against by indictment for creating a nuisance. But with regard to overhead wires, it has been laid down in a case by the Wandsworth District Board against the United Telephone Company, respecting a wire across High Street, Putney, that the road authority in a town in whom the streets are vested by Act of Parliament has no veto upon the erection of a wire across a street, provided that the wire is suspended from supports which are not fixed upon the road; that it crosses the road at a height above the ordinary user of the road; and that it does not threaten danger or damage to the public. Road authorities in country districts, where the surface of the roads is not vested in them, have no greater rights than urban authorities; and the position of the telephone companies, therefore, appears to be that they may erect wires across a highway unless they are likely to be dangerous to the public. But on the other hand, there are some cases in which the soil of a street is vested in a corporation, or some other body or persons, not by virtue of Act of Parliament, but as an ordinary question of property, and in such cases the erection of a wire, apart from the question of danger or nuisance, must be treated as a trespass, and dealt with accordingly. Apart, however, from the general law applicable to telephone wires, several corporations have obtained Acts giving them special powers for regulating these wires. In some of these Acts the Corporation is empowered to make bye-laws (to be approved by the Board of Trade) for the inspection, execution, prohibition (except by licence), and removal of telephone wires, together with a right to recover penalties against offenders; and in cases where a wire may not be erected without a licence, an appeal to a court of summary jurisdiction is given against an unreasonable withholding of assent. Over and above these restrictions upon telephones, the Post Office has the power to practically forbid their erection by refusing the licence which every telephone company must obtain, and in so acting is subject to no check except by proceedings in Parliament, but control of that kind is not easily exercised or very effective. This being how the matter stands as to telephones, Mr. Hunter advises that all persons desiring to erect overhead telephone wires should have the same powers as the Post Office in respect to roads; and, further, that licencees of the Post Office, and only such persons, should also have the same rights as the Postmaster-General possesses as to laying down underground wires—both provisions, however, being subject to the condition that the Postmaster-General should have notice of every intended wire, and that he should have a veto upon the proposal if he considers that the wire will injure any Post Office wire, or occupy space which he will

require for Post Office purposes within a limited time. With regard to electric lighting wires, the the Act of 1882 distinctly forbids the laying of wires along, over or across any street or road without the express consent of the local authority, and also gives a right of appeal to a court of summary jurisdiction to any person against an overhead electric wire, even though the consent of the local authority has been obtained.

During the same sitting Mr. Graves, engineer to the Post Office, furnished some information as to the difference between overground and underground wires, pointing out that the latter were very much more expensive than the former, for reasons which will be apparent to everyone. Incidentally, in the course of the proceedings, the question was raised whether the committee should take into consideration the bill promoted by the United Telephone Company, and eventually it was decided that that should not be done.

Having proceeded thus far with the Post Office case, the Committee took up that of the telephones, and received the evidence of Mr. Joseph Bond Morgan, Managing Director of the United Telephone Company, and, as the representative of that Company, a Director of the National, the Lancaster and Cheshire, and several other telephone companies. The United Telephone Company, he stated, was constituted, in 1880, out of the Edison and Bell Companies, and the Post Office granted a licence for 31 years to work telephonic exchanges within a radius of 5 miles from the General Post Office; but last year a fresh licence, fixing no limit of radius, was granted. Ten per cent. of the subscriptions is taken as a royalty by the Postmaster-General. The company charge £20 a year to each person using their telephones within the metropolis. Besides their central exchange, the company have 18 district exchanges in London, and also a special exchange in Bartholomew House for the use of the Stock Exchange; and they have also supplied 817 private lines, connecting firms and companies with each other. Except in a few subways, all their wires are overhead wires, and of these wires they have five thousand miles. During last year the company sent no less than 15,565,406 messages; the Lancashire and Cheshire Company sent 7,916,774, and the National Company 13,648,756; and the total sent by all the companies during the year was 41,648,756. These companies, Mr. Morgan explained, possessed no compulsory powers, but had carried on their work under sufferance, making the best terms they could with owners and occupiers for attachments and erecting poles, in some cases paying a small annual sum for the permission. Without permission they never erected poles or made attachments on private property, but they did pass wires over such property without permission, just as the Post Office did. At the same time, they did not claim to have a right to do this, and they might be required to remove such wires; but, on the other hand, they held that they had a right to cross streets without the consent of the local authorities, such authorities having no such property in the soil as to enable them to interfere with wires so laid unless they were so near the level of the street as to impede the traffic or be dangerous to the public. To avoid that difficulty, however, they put their wires at such an elevation as to clear all possible traffic, and even the tallest fire-escapes. To show the character of the telephone wires, Mr. Morgan produced and described a number of specimens, some enclosed in cables as stretched in mid-air. The ordinary wire is a 3-strand, No. 16, gauge iron wire, weighing 10 lbs. to the 100 yards, with a breaking strain of from 700 lbs. to 800 lbs.; but in some cases the company use a phosphor-bronze wire, a 2-strand wire, weighing 2¼ lbs. to the 100 yards, and requiring a breaking strain of 250 lbs. They also use a large number of aerial cables, containing as many as 30 or 40 wires, with a 3-strand No. 16 galvanised wire as a core. These are suspended upon strong iron wires, but they are stated to be quite capable of bearing their own weight without these suspenders, and ever since the company began their operations there have been no accidents causing injury to persons through a wire breaking. The cost of each message sent, reckoning each communication as two messages, Mr. Morgan estimated at slightly over 1d. in London, and 1·08d. throughout the kingdom; and the total revenue of the various companies he put at something like £250,000—£25,000 of which went to the Post Office. From the fact that with no compulsory powers, and in face of many disadvantages, the companies had been able to make so much progress by means of overhead wires, Mr. Morgan argued that there was no general objection to such wires, and he urged that, with a more liberal granting of licences by the Post Office, the telephonic system could be immensely extended without difficulty, and to the great advantage of the commercial community at any rate. But, as at present, any person over whose property a wire may run could compel its removal, and in that way a good deal of black mail was levied on the companies, it was necessary, in the public interest, to create greater facilities for erecting wires. On the question of cost, Mr. Morgan compared the relative expense of underground wires, pole-supported wires, and over-house wires, showing the last to be almost trifling as compared with the other modes; and to illustrate the importance of this consideration, he reminded the committee that inasmuch as neither the collection nor delivery of telephone messages was allowed, every subscriber had to be supplied with a separate wire into his house or office, these wires radiating in every direction. Under ordinary circumstances, a telephone wire overground would not cost more than about £10 a mile, but a below ground wire system would be so costly as to prove prohibitory, because people would not pay the large subscription which would then be necessary. After enlarging upon the value of the telephone for business purposes, Mr. Morgan pronounced against Mr. Hunter's proposed tribunal as involving delay and uncertainty, and advised greater liberty of action generally, and an absolute option to the companies as to putting their wires beneath or above the ground. As to the matter of control, he urged that the various local authorities in the metropolis should draw up a set of bye-laws to which they all agreed, and these being approved of by the Board of Trade, the companies would be content to be guided by them. In some supplementary statements, Mr. Morgan again spoke emphatically upon the inconvenience, danger, and other grounds of objection to underground wires, and said that if his company were obliged to so lay the wires they would require perhaps an additional two millions of capital, and would have to raise their subscription to £80 or £100. Moreover, danger would be involved to the public in busy thoroughfares through the necessity of constantly opening up the streets for repairs and laying down new wires; and, further, the confined moisture in the underground tubes would seriously injure the wires.

Mr. Spagnoletti, the telegraph engineer of the Great Western Railway Company, confirmed generally the views of Mr. Morgan, speaking from an experience of 36 years of the erection of telegraph wires. He expressed the opinion that the telephone system could not have attained its present dimensions but for the convenience of running the wires overhead, and he estimated that such wires, including poles and other appliances, cost only about £70 or £80 a mile, while underground wires would cost nearer £480 a mile. Besides that great cost, the trouble and public inconvenience of breaking up streets would render an underground system quite impracticable; and, on the other hand, the experience gained, and the mechanical improvements made in recent years, enabled engineers to erect overhead wires with perfect safety, and without annoyance to anyone. In connection with the question of safety, Mr. Spagnoletti described a number of tests made in London and elsewhere, the general effect of which went to show that even if a wire broke it would cause little danger to the street beneath, and that a greater breaking strain was required for wires which had been up a few years than for those of briefer existence.

The bill of the United Telephone Company, referred to before this committee, is a measure of 20 clauses, and is at present in the House of Lords, having progressed but a very short way. Its object is "to afford to the United Telephone Company additional facilities for telephonic communication," and its provisions may be briefly indicated. The company ask for powers to run telephone lines along roads or under roads in the Metropolis and within a radius of 100 miles from London, subject to various restrictions. They also seek authority to pass wires over private property upon payment of compensation for any damage done, subject to the wires being placed a certain specified distance above the ground or the roof of a building, and also to a provision requiring the company to remove the wires if the owners require to use their property for purposes with which the wires would interfere. They further propose that limited owners shall have liberty to grant way-leaves for wires during their ownership, full power of approval or otherwise being, however, reserved to the reversioner. Ample safeguards are provided as to compensation, penalties, rights of local and other authorities, Crown property and the privileges of the Postmaster-General.

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**The Telephone in Lancashire.**—Since the new license of the Postmaster-General was granted to the telephone companies, no time has been lost in developing the usefulness of the telephone. Manchester and Liverpool have both about eleven hundred subscribers, and telephonic exchanges, which are connected with each other, have now been established in the following towns:—Manchester, Liverpool, Bolton, Warrington, Ashton-under-Lyne, Rochdale, Middleton, Heywood, Bury, Radcliffe, Oldham, Stalybridge, Stockport, St. Helen's, Widnes and Runcorn, Wigan, Blackburn, Preston, Burnley, Accrington, Darwen, and Chorley. Other centres of population will shortly be added, and the principal towns of Yorkshire are to be connected at an early date. Facilities are afforded for joining the trunk wire system by an extra yearly subscription, or by a toll per message, as best suiting the circumstances. To meet the needs of non-subscribers, offices have been opened in tradesmen's shops and other places, from which conversation may be obtained with any subscriber to the local exchange for 3d., and with any subscriber in any of the towns named for 6d. Only three minutes conversation is allowed, and as soon as connection is made a clockwork arrangement slowly moves an index finger (visible to the user) over a graduated arc. At the expiration of the stipulated time the connection is automatically severed. It may be stated that one of the longest telephone circuits in the North of England is that from Manchester to Preston *viâ* Liverpool, the distance being about eighty miles.

## NOTES.

**Electric Lighting at the Inventions Exhibition.**—We are informed that the five arc lamps to be used in the illumination of the Old London Street at the forthcoming exhibition are not Mackie lamps, but the Lea lamps which lighted Old London last year, and the United States and Canadian Courts of the Fisheries Exhibition.

**Lighting Hospital Ships by Electricity.**—The Metropolitan Asylums Board has let the contract for lighting, by means of electricity, the hospital ships and buildings at Long Reach, to Mr. James Johnston, 4, Albert Square, Manchester. The plant will be in duplicate throughout, and a considerable saving in the annual cost of lighting will be effected by the substitution of electricity in the place of oil.

**Electrically Lighting Ironworks.**—The lighting of ironworks by electricity is gaining additional favour among ironmasters, states the *Engineer*. Messrs. E. T. Wright and Sons, of the Monmoor Ironworks, Wolverhampton, have a portion of their works lighted by electricity, and it is costing less than when they used gas. The firm has determined to further adopt the process in a few months if the results continue as satisfactory.

**Chemical Aspect of Electric Lighting.**—At the ninth ordinary general meeting of the Philosophical Society of Glasgow, held last week, Mr. J. J. Coleman, F.C.S., F.J.C., president of the chemical section, read a paper "On the liquefaction of atmospheric air and other effects of extreme cold; and on artificial light, and other phenomena of high temperature." In the course of his paper, Mr. Coleman said that electric lighting in these days of dynamos was considered to be a mechanical operation, but in most cases this force had a chemical origin by the burning of coal. Although the use of zinc in a galvanic battery was said to be more costly than that of coal under a boiler, he thought iron might be used instead of zinc. He had constructed Daniell's batteries with iron instead of zinc; and he stated that the sulphate of iron produced as a waste product in such a battery could be distilled and the sulphuric acid used over again by combining it with the deposited copper. He pointed out that gas might have other rivals besides the electric light, and showed how liquid fuels, such as were got in America and Russia, could be burnt in asbestos wick lamps by the agency of compressed air.

**The Electric Light for Egypt.**—Mr. J. Church, who has been for some years connected with Messrs. Siemens Bros., left England this week for Suakin. He has joined Messrs. Lucas and Aird, the contractors for the Suakin-Berber Railway, as their electrician. We hope that before Mr. Church reaches his destination Osman Digna and his forces will no longer be in a position to give us cause to feel anxiety respecting the safety of our countrymen in Egypt.

**Building Trades Exhibition.**—At the exhibition held during last week and this at the Agricultural Hall, Islington, Messrs. Gretton, Mynn & Co. supplied the electric light to such of the stall holders as desired to have it; the number of those who availed themselves of the opportunity being, however, very limited. The Grubbe incandescent lamp was used, about 120 being served by an Edison dynamo, driven by a portable engine belonging to Messrs. Houghton Brown Bros., of Kingsbury Ironworks. The usual display of electric bells and alarms was made at the stands of Messrs. Eck, Callow & Co., Messrs. Woodworth and Lowth, Mr. W. Pressland, and Mr. Julius Sax. Messrs. Eck, Callow and Co. exhibited a church bell made of Delta metal, weighing 4 cwt., actuated by electricity. Amongst the exhibits of engines were the small power steam engines of Mr. E. S. Hindley, which have been found suitable for electric lighting purposes; and also the new gas engine, "The Stockport," by Mr. Andrews, said to be an exceptionally steady runner.

**Electric Lighting Tests at Philadelphia.**—We learn that as a direct outcome of the Electrical Exhibition, a series of dynamo and incandescent lamp tests is now in progress at Philadelphia, which is stated to be among the most important of the kind ever made. The mechanical preparations for testing dynamos were completed and the electrical preparations were finished Saturday, March 7th. After a series of experiments, the Tatham dynamometer was selected for use in the dynamo tests. Mr. Edison has three dynamos of 100, 200 and 400 ampères respectively, with E.M.F. of 120 volts, requiring 20, 40 and 80 horse-power. Mr. Weston has two incandescent dynamos and one arc dynamo, ranging from 35 horse-power up. In the lamp tests, power will be furnished by a 25 horse-power engine, and the current will be supplied by an Edison dynamo of 100 amperes, the speed of which is gauged by means of a tachometer, and Weston's automatic regulator is used for the field. The Edison voltmeters are in constant use at different points, for the purpose of observation, and an Ayrton and Perry current meter is also in use. Special effort has been made to obtain regularity of speed and electric current. The incandescent lamps entered for the duration test are: Edison, 20 lamps of 16 candle-power; E.M.F., 96 volts. Weston, 20 of 16 candle-power; E.M.F., 110½ volts. Stanley, 10 of 16 candle-power; E.M.F., 92 volts; and 10 of 16 candle-power; E.M.F., 42 volts. Woodhouse and Rawson, 10 of 16 candle-power; E.M.F., 55 volts—making in all 70 lamps. The room in which the duration tests are to be conducted has 70 cells, 6 inches square, arranged in a circle with a radius of 100 inches. Each lamp will be subjected to photometric, current and potential measurements made each day during its life. The room is carefully guarded by two attendants, who sleep in rooms on each side of the test room, and in addition two special watchmen will guard the lamps night and day. At the close of the photometric experiments each day, the only door of the room will be carefully sealed by the committee and companies represented, and will not be opened until the next day, for a repetition of the experiments. The instruments used have nearly all been specially constructed for this work. The Methven standard two-candle burner is used in the photometric tests, while the lamp is presented in 60 different positions, by means of an ingenious arrangement which revolves in two circles at right angles to each other, and whose planes can be altered.

**The Starr Incandescent Lamp.**—In reference to this lamp, a correspondent of the New York *Electrical Review* writes to correct the statement in the article on "A Short History of Incandescence Lamps," published by us a few weeks ago, that:—"Mr. Peabody supplied him (Starr) with the means necessary for a journey to Europe, in order to enable him to lay his invention in a practical form before his British colleagues and the British public." The person who really furnished him with the means, says the correspondent, was Mr. P. P. Lowe, a well-known lawyer still living in Dayton, O. Though not a scientific man, Mr. Lowe saw at once the great value of Starr's invention, and advanced $4,000, the amount necessary for the before-named purpose, accepting, as recorded, a contract still in the possession of Mr. Lowe's daughter, a share of the proceeds in payment for the loan. Mr. Peabody did agree, if Faraday gave his sanction to the invention, to advance money for its manufacture.

**The Electric Light in the Soudan Operations.**—Last Sunday night, after the repulse of the Arabs who made the desperate attack on the zariba between Suakin and Tamai, our brave men remained on the *qui vive* for hours in darkness and under most depressing influences. The correspondent of the *Times* with the force stated that as he wrote six dead Arabs lay stretched out at his side. Writing at 1 a.m. on Monday morning, he said: "The electric light from the *Dolphin* in the harbour, six miles away, is visible at intervals. As its long and brilliant beam sweeps around the plain and over us it cheers our hearts."

**The Economical Use of Fuel.**—The *New York Electrical Review* says it was clearly brought out in the discussions at the Electric Light Convention that upon no subject is there more diversity of opinion, or more lack of exact knowledge, than upon that which concerns the economical use of fuel. And yet upon this, success or failure of electric lighting as a commercial enterprise very largely depends. The estimates given by different persons, founded upon their own experience, differed widely as to fuel cost per light per night. Of course there would be more or less difference, based upon the varying cost of coal in different places, but the divergences noted were by far greater than this would account for, and are to be attributed, in large part, to the different ways of handling fuel, rather than to differences in the fuel itself. This much seemed settled: Those whose grates are so arranged as to leave ample space between the bed of fire and the bottom of the boilers, and who have some suitable arrangement for supplying an adequate amount of fresh air, not only to the fire itself, but to the unconsumed gases beyond the fire, so as to secure their complete combustion, got the best results, while those whose boilers were so set as not to secure these conditions found themselves burning a very large amount of coal, without adequate return in the form of steam.

**Lighting of United States Government Steamers.**—Messrs. Armington and Sims have received orders for engines to be used on all the Government steamers used by the Mississippi River Commission, on which the Edison and Thomson-Houston systems are being installed.

**Railway Station Lighting.**—It is stated that when the extensive improvements now in progress at Victoria Station, Manchester, have been completed, the new buildings will be illuminated by the electric light.

**The Proposed Telephonic Exchange for Portsmouth.**—The committee appointed by the Chamber of Commerce to negociate with Mr. Lewis, manager of the Western Counties and South Wales Telephone Company, with reference to the establishment of an exchange at Portsmouth, had an interview with that gentleman last week, with a satisfactory result. Mr. Lewis agreed that a one mile radius should be drawn from St. Luke's Church, so as to include the whole of Palmerston Road, Southsea, and the important business districts of Portsmouth. If it is found that a return wire is necessary, the company will be prepared to fix the same at £3 10s. per mile of wire. To all members signing the agreement on or before the 31st of March, the rental will commence on the 1st of July, thus giving them two months gratuitous use of the exchange. The charge per member is to be £10 a year, but the company will be prepared to fairly meet those who may have more than one establishment in connection with it. The matter was subsequently considered at a meeting of the Chamber of Commerce, when it was resolved that nothing further should be done until the company had ratified the verbal agreement entered into by Mr. Lewis, on its behalf. The company is now pushing on with the greatest possible despatch the work of establishing the exchange, and names of subscribers are already being taken.

**The Bristol Telephonic Exchange.**—This exchange is, we are pleased to hear, progressing most satisfactorily; the subscribers now numbering upwards of 300. Although in some instances the wires run parallel to the distance of two or three miles, the induction resulting therefrom is comparatively slight, and very few complaints are received.

**Underground Telephone Cables.**—The Birmingham Telephone Exchange Company is substituting underground cables for overhead wires along a further portion of its service in the very busiest part of that town, namely, between Bennett's Hill, where the company's offices are situated, and Stephenson Place.

**Music by Telephone.**—On the occasion of the recent visit of the Carl Rosa Opera Company to the Manchester Theatre Royal, some very interesting experiments in the transmission of music by telephone were conducted. On the evening upon which Sir Julius Benedict personally conducted the opera, a party of science teachers assembled at the central telephone offices to listen to the music. The transmitting instruments were fixed at the theatre, and the music was heard with a very pleasing effect. At intervals during the experiment strains of music not in the opera were faintly heard. These sounds, it was found, had been picked up by induction from a wire connected with the Prince's Theatre. During the intervals of the performance at the Theatre Royal, the Prince's Theatre was switched on to the receivers, and the music from that theatre was then distinctly heard. The same evening music was telephoned from Manchester to Liverpool, Blackburn and Preston.

**The Western Counties and South Wales Telephone Company, Limited.**—The prospectus states that this company has been formed for the purposes of acquiring the business of the United Telephone Company, Limited, in the West of England and South Wales, and of developing telephone business throughout Cornwall, Devonshire, Somersetshire, Dorsetshire, the Channel Islands, Hampshire, the Isle of Wight, Wiltshire, Gloucestershire, Herefordshire, Monmouthshire, Glamorganshire, Carmarthenshire, Pembrokeshire, Cardiganshire, Brecknockshire and Radnorshire and all such parts of Shropshire, Warwickshire and Worcestershire as are not included in a twenty miles radius from the General Post Offices at Birmingham and Wolverhampton respectively. The Post Office authorities have granted the company a licence which permits it to open exchanges at all places within the above-mentioned extensive district, and to connect the various cities and towns by trunk wires, and also, by arrangement with the United Telephone Company and its subsidiary companies, to connect places in this district with those in other districts throughout the United Kingdom. It can also connect its various exchange systems with the Post Office telegraphs, by which means subscribers may receive and forward their telegrams by telephone. Public call offices may also be opened where, upon payment of a small fee, the public can communicate with any subscriber to the exchange system. The revenue arising from the company's existing business exceeds £6,400 per annum, and the nett revenue is more than sufficient to pay the preferential dividend upon the capital now proposed to be called up. The orders already awaiting execution will produce an increase of receipts amounting to over £1,200 per annum. The Bristol Exchange was opened in December, 1879, and has now 297 subscribers connected and 40 further orders on hand, a number which will no doubt be largely and rapidly increased. The daily calls to the exchange have exceeded 2,000. There are in addition 61 private line renters, with 16 orders on hand for Bristol and its district. The United Telephone Company on December 12th, 1884, reopened an exchange (now belonging to this company) for Plymouth, Stonehouse and Devonport, where a large business is expected. In Devonshire, Cornwall, Hampshire, Gloucestershire and South Wales numerous private lines are in operation, and other orders are on hand. The United Telephone Company as vendors will receive £14,500 as an agreed sum to repay the balance of their expenditure from the year 1879 to August 31st, 1884, after crediting gross receipts, and the balance of their actual expenditure since that date, and will also receive 160,000 fully paid ordinary or deferred shares, and as patentees an annual royalty of £2 for each set of instruments or other royalties as may be agreed.

**Telephone Extension in Scotland.**—We understand that the National Telephone Company is about to open an exchange at Helensburgh, the required number of subscribers having been obtained.

**The Telephone for Life-Saving Purposes.**—News comes from America that the men of the life saving service along portions of the Atlantic coast are feeling very much the want of telephonic communication. A special appeal comes from the exposed shores of New Jersey and Long Island.

**The Telephone Company and the Mormons.**—The Rocky Mountain Bell Telephone Company is experiencing trouble at Salt Lake City. The stand the United States officials have taken against polygamists has caused quite a number of the interested saints to visit foreign parts, and the telephone collector finds his bills accumulating on his hands, and no funds forthcoming.

**Standard Switch-boards.** — It is stated that the Western Electric Company is quite busy in the switch-board department, having recently received orders for upward of 93 Standard switch-boards for export.

**Bell Telephone Patents in Canada.**—A writ of *certiorari* was applied for at Toronto, on February 25th, before Judge Galt, to bring up all proceedings taken before the Minister of Agriculture, at Ottawa, in the Bell Telephone Company's patent case, with the object of moving there to review the minister's decision. Judge Galt thought the questions raised of sufficient importance to warrant him in sending the motion for argument before the common pleas divisional court in May next, and granted an order accordingly.

**Serious Damage to Telegraph Apparatus at Portsmouth.**—Considerable damage was done to the telegraph wires and poles at Portsmouth and the neighbourhood on Sunday during the severe snowstorm. Both the Post Office telegraphs and the railway wires were interrupted, the one wire which was left intact being that to Brighton, by means of which messages to London were transmitted. During the morning great consternation was caused by a massive iron telegraph pole on the top of the post office in High Street, Portsmouth, becoming dislodged, but fortunately one of the stays held securely, and thus prevented it from rolling off the roof into the street. The wires in Portsmouth Dockyard appear to have suffered quite as severely, and the only wire from the office of the Commander-in-Chief that was not snapped was that communicating with the General commanding the Southern District. Of the eighteen wires that span Anchor Gate Road, just outside the Dockyard, no less than nine were snapped and others damaged, whilst several poles were blown down. The War Office telegraphs and telephones were also rendered temporarily useless, but the telephones connecting the various police stations at Portsmouth were not in the least affected. It is many years since such a delay has been caused in the telegraph service in this neighbourhood.

**Sixpenny Telegrams.**—Replying to Dr. Cameron in the House of Commons on Monday, Mr. S. Lefevre said it was impossible to deal with the important question of the introduction of sixpenny telegrams without amending the Telegraph Act, and accordingly he had given notice of the introduction of a Bill on the subject.

In the annual report of the Birmingham Chamber of Commerce, presented to the members on the 26th inst., it is stated that a petition was forwarded to the Postmaster-General, pointing out that, whilst the Treasury was in possession of a postal surplus of £3,000,000, it appeared incongruous to delay the adoption of a new service, which must prove a great convenience to trade and to the public, because of a temporary loss of £180,000, which had occurred in the Parcels Post service. The delay in the introduction of sixpenny telegrams, for financial reasons, showed the prejudicial effect of the practice which had led to the appropriation by the Treasury of almost the entire postal surplus.

**Telegraphic Deficiencies.**—Commenting on the great deficiency in postal and telegraphic convenience existing in the Western Islands, the *Oban Telegraph* says that poor little Greece can do what the great United Kingdom cannot do. It has an island system vastly greater in proportion than ours, and all its islands are connected, or about to be connected, by wire. "Postal and telegraphic niceties are lavished on every nigger potentate, and furnished for every monetary swindle that can connect itself with the London Stock Exchange. But the simple decencies or absolute necessities of intercommunication with regard to our own islands we cannot perform, and while it takes but eighteen minutes to send a message round the globe, it takes eighteen days to send one to Tiree."

**Telegraph Revenue.**—The receipts in the telegraph service from April 1st, 1884, to March 21st, 1885, amounted to £1,680,000, as against £1,675,000 received from April 1st, 1883, to March 22nd, 1884.

**The Extra Current in Dynamo Machines.**—At one of the recent meetings of the *Academie*, M. d'Arsonval recommended, as a means of protection against the danger from the extra current on breaking circuit in dynamo machines, the interposition of a battery of polarisation between the poles of the machine. M. Raynaud suggests that it would be useful to try for the same purpose lightning protectors, such as are used in telegraphy, for protection against atmospheric electricity. It would suffice to connect with the poles of the machine the terminals of an instrument of this kind, which would form thus a kind of safety valve, giving no passage to the current except at the moment when it becomes dangerous. He would select, according to circumstances, the protector with plates and insulating sheets (air, mica, gutta percha, paper, &c.), or with points, or with plates and points, &c.; or even, in certain cases, rarefied air or alcohol protectors. The experiments of Messrs. Warren de la Rue and Müller upon the disruptive discharge would throw much light upon the question as they make known the explosive distances in air at ordinary pressures, and between surfaces of various forms, for differences of potential varying from 250 to 12,000 chloride of silver elements the electromotive force of each being 1·03 volts.

**Telegraphs v. Pneumatic Tubes.**—The *Leeds Mercury* in informing its readers that the story that the telegraphs between London and Paris are about to be replaced by a pneumatic tube is possibly one that ought to be taken with a grain of salt, points out that there is no reason why such a means of communication should not be brought much more into use in this country, its adaptability being by no means exhausted by its being employed to connect various London post offices with St. Martins-le-Grand. A proper system of pneumatic tubes would greatly facilitate business and render business men to a large extent independent of the telegraph.

**Gas v. Electric Light.**—An exhibition of gas stoves and other apparatus was opened on the 24th inst., at Bilston, under the auspices of the Gas Light and Coke Company. One of the speakers at the exhibition stated that gas companies ought not to be afraid of the competition of the electric light, since that was a luxury. For years the gas and electric light companies might work together, and when the electric light did compete as an illuminant—if ever it did so—gas would be used for many other industrial purposes.

**Pluralist Directors.**—The recently published *Directory of Directors* reveals the fact that Sir H. W. Tyler, M.P., is now chairman or director of seven companies; Mr. James Brand and Mr. George Wodehouse Currie, of nine; Mr. C. E. Lewis, M.P., Mr. G. Forman, Mr. J. W. Maclure, and Sir C. C. Clifford, of ten; Mr. James Staats Forbes and Mr. J. G. Goodson, of eleven; Mr. E. M. Underdown and Mr. Luke Bishop, of thirteen: Mr. Pender, M.P., of fourteen, and Mr. J. W. Batten of fifteen.

**Electrical Tramways.**—On Tuesday evening, Mr. Holroyd Smith delivered a lecture in the Assembly Rooms, Blackpool, on the development of an electric tramway. The Mayor presided, and in his introductory remarks said that, although the Blackpool Corporation—and Blackpool through them—deserved credit for the introduction of the electric light, he thought that those gentlemen who were backing up Mr. Holroyd Smith deserved more credit still, for they were finding money themselves out of their own pockets, while the Corporation in the other case were simply finding public money. He did not see why they should not put on electricity as they put coals on a steam engine, and use it there and then. With respect to the generation of electricity, he should like to see Mr. Holroyd Smith and other experts in electrical matters, discover some different method. Mr. Smith then delivered his lecture, which was illustrated by a number of experiments; he explained, with much fulness of detail, the method which is being adopted in Blackpool, and made it clear that he is thoroughly familiar with the work he has taken in hand, and that no part of it has been overlooked. The various materials employed in the construction of the line on the front were illustrated in detail, and certain objections made against the use of electricity for tramway purposes were dealt with in the clearest and most forcible manner. The lecturer stated that about 86 per cent. of the electricity generated at the depôt could be converted into power. In responding to a vote of thanks, the Mayor took the opportunity of expressing his favourite opinion relative to the movement, which was that "it was not wise to count the chickens before they are hatched."

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**Generous Offer by Workmen.**—The puddlers and middlemen employed by Messrs. William Cooke & Co., of the Tinsley Steel, Iron, and Wire Works, Sheffield, last Monday sent a deputation to the manager offering a week's work for nothing, in consequence of the difficulties under which the company has laboured by reason of the stagnation in the iron trade.

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**The Electrical Exhibition at the Observatoire de Paris.**—With respect to this exhibition, of which we gave a preliminary notice last week, we may add that the motive power required for the lighting and for the demonstrations of transmission of power to a distance represents about 200 H.P., furnished by eight engines. Among the apparatus installed is a new dynamo-electric machine giving continuous and alternating currents, exhibited by M. Biétrix, the armature of which is wound in a novel and original manner; another machine with six poles by M. Brown d'Oerlikon, excited in derivation, which seems to be very similar to the corrected current machine of M. Radiguet; the peroxide of lead battery of Messrs. Radiguet and Tommasi; batteries and accumulators for electric jewellery by Mr. Trouvé and M. Aboilard; Clamond thermopiles; the incandescence lamps of M. Anatole Gerard, and those of Cruto, manufactured by the maison Mildé. The transmission and distribution of energy was shown by the Compagnie Electrique in a variety of ways. So there was, it appears, no lack of attractions to make the exhibition a real success.

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**Memorial Library of the Philadelphia Exhibition.**—Mr. E. Hiltebrand, librarian of the Franklin Institute, Philadelphia, under the auspices of which the recent electrical exhibition was held, has compiled a catalogue of the memorial library formed in connection with the exhibition. The catalogue embraces the publications received up to December 31st, 1884. The committee on Bibliography, who were responsible for the collection, state that they have secured a satisfactory representation of the current literature of electricity, a valuable collection of author's reprints and other special investigations bearing on the subject, and a small proportion of the non-current and historical literature.

**The Post Office Telegraphs.**—A Parliamentary paper just issued shows the gross amount received and expended in respect of the telegraphic service from the date of the transfer of the telegraphs to the State to the 31st of March, 1884. The gross amount received for telegrams in that period was £18,225,778, and the amount expended in the working of the department was £16,662,347, and £2,395,082 remained as a balance to meet interest on stock created on account of the telegraph service and the redemption of debt. The total receipts for 1884 amounted to £1,789,223, leaving a balance of expenditure over receipts of £19,697. It is estimated that the telegraphic services performed for public departments without remuneration last year were worth £25,775; and since 1870 those free services amounted to £187,008 in value.

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**The Gramme and Cabella Armatures for High Yield.**—*L'Electricien* says: "On February 7th, we described the new Gramme armature, pointing out its great resemblance to that of Signor Cabella, and remarking that the two inventions had been made independently and almost simultaneously. We mentioned that the French patent of M. Gramme is dated March 7th, 1883, whilst that of Signor Cabella is of April 16th of the same year. Signor Cabella writes today that his Italian patent is dated February 19th, 1883. We put on record this declaration of Signor Cabella, which confirms what we said concerning the independence and simultaneity of the the two inventions."

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**A Story About Edison.**—The *Electrical World* relates what it terms rather a good story which is being told at the expense of Edison. He has lately taken to wearing a high silk hat. Walking up from his east-side laboratory the other day, in his customary fashion, hands clasped behind his back and eyes seeking the earth, he was much astonished to observe that the boys and girls made way for him with many marks of deference. Some took off their caps. Finally, he was stopped by one little fellow, who said:—"Father O'Brien, me mother, Mrs. Maloney, of Avenue A, bids me ax your Rivirince, since you be so oftin passin', to be kind enough to drop in on me grandmother, Mrs. Foley, who is clean gone with the rheumatism." "Father" Edison now wears his hat on one side and smokes a big cigar in going to and from his laboratory, much to the bewilderment of the youth of Avenue A.

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**The Society of Telegraph Engineers and Electricians.**—On the 12th inst. Sir David Salomons read a paper before this Society on "Constant electromotive force in an electric light circuit." On the same evening a paper by Mr. Andrew Jamieson entitled "Electrical definition, nomenclature, and notation," should also have been produced, but as the discussion on the former subject lasted till the break up of the meeting, Mr. Jamieson's paper was presumably postponed for the next gathering of the members, yet on Thursday last this was shelved for still another article "On the seat of electromotive force in a voltaic cell," by Professor Oliver Lodge. As we, in the interests of our readers, usually publish the notices of the Society as they are sent to us, perhaps someone can inform us why Mr. Jamieson's paper was not read as publicly announced.

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**The Value of Electrical Patents.**—We were under the impression that the time had gone by when an inventor, possessed of patents for electric lighting, *i.e.*, dynamo, arc and incandescent lamps, accumulators, and the various accessories which go to make up a complete system, could reasonably expect to pocket something approaching £100,000 for his patent rights. We observe, however, that the purchase consideration for what we believe to be the Trouvé portable lamp, as illustrated in the ELECTRICAL REVIEW for December 6th, 1884, is fixed at £70,000. Perhaps this is an error, and the real price is the above sum divided by ten.

**City and Guilds of London Institute.**—The Lord Chancellor presided on Wednesday afternoon at the annual meeting of the governors of this institution, held at the Mercers' Hall, Cheapside. The fifth annual report referred, among other things, to the technological examinations, and it was stated that the number of candidates who presented themselves for examination last May was 3,635, showing an increase of 1,238 on the previous year, this being the largest increase that had yet been apparent in any two consecutive years during which the examinations had been held, and the result of the examination was equally satisfactory, for last year 3,625 candidates were examined at 164 centres in 43 subjects, of whom 1,829 passed, while in 1883 there were 2,397 candidates in 154 centres in 37 subjects, and 1,498 passed. The gross income of the institute for the year amounted to £25,864 18s., including subscriptions (£24,122 10s.) and school fees (£1,661 7s. 1d.). The subscriptions showed an increase of £652 10s., and there was a slight increase perceptible in the school fees. The total expenditure in connection with all branches of the institute's operations amounted to £17,346 11s. 8d., as against £15,186 2s. 5d. in 1883. The Lord Chancellor moved the reception and adoption of the report, and remarked that the chief event of the year was the opening of the central institution, which he hoped would be in full working order before the close of the present educational session. The four principal professors had been already appointed—Professor Armstrong, of the Finsbury Technical College, Professor Ayrton, Professor Henrici, and Professor Unwin had been appointed to the chairs of chemistry, of physics, of mechanics and mathematics, and of engineering respectively. Lady Siemens, the widow of the eminent electrician, Sir W. Siemens, had placed at the disposal of the council the sum of £1,500 for the foundation of a scholarship, in memory of her husband, and with the view of more closely associating the memory of Sir W. Siemens with that branch of applied science in which he took so deep an interest. Lady Siemens had also kindly promised to found a memorial medal to be given each session to the most proficient student of the central institution in the department of electrical engineering. The most important feature of the work of the institution was the technological examinations. The number of technical classes throughout the country held in connection with the scheme of examination of the institute, and the attendances of students at those examinations were highly satisfactory. The addition of practical tests to the written examinations previously held constituted a new and important feature in the conduct of those examinations, and it was desirable that they should serve the double purpose of improving the trades in connection with which the examinations were held, and of affording a test which should satisfy employers that the holders of the institute's certificates were practical workmen as well as scientifically acquainted with the principles of their trade. The results achieved had been very encouraging. The Lord Mayor seconded the adoption of the report, and the resolution was carried. Sir Sydney H. Waterlow was re-elected treasurer of the institute. The Council of Management and the auditors were re-elected, and the customary votes of thanks having been accorded, the proceedings were brought to a close.

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**Legal.**—An application was made before Mr. Justice Lopes and Mr. Justice Cave last week on behalf of Mr. Cyrus Field for an order for substituted service of a writ upon Mr. James Gordon Bennett, proprietor of the *New York Herald*, against which paper Mr. Field has brought an action for libel in connection with the recent proceedings at the meeting of the Anglo-American Telegraph Company. The application was refused, the Court holding that the rules as to substituted service were intended to apply only to cases where it was possible to serve the defendant if he could be found.

**Electrical Governors for Engines.**—The Willans' electrical governor, now in use at the Edison and Swan Company's electric light installation at Victoria Station (L. C. & D. Railway) seems to be an apparatus of considerable value. It is said that by its means a variation in electromotive force of 1 volt only was the greatest difference observed during a four hours' run, although the variations in steam pressure and current were very considerable during that time.

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**Electrical Training Gear.**—Our Portsmouth correspondent writes that an invention, indicative of the revolution which electricity is destined to make in modern warfare, was tested a few days since at the Garrison Point Fort, Portsmouth, with highly satisfactory results. It consists of an electrical training gear so ingeniously contrived that by the simple movement of a handle a single man can manipulate the heaviest gun in any direction. The handle is pulled to the right, and the breech of the gun moves to the right; to the left, and it moves to the left. The handle being raised the gun is depressed at the muzzle and *vice versâ*. The gear was applied to a 38 ton gun, and it was found that by this means it could be aimed at quickly moving objects almost as easily as if it were a pistol. Mr. Maxim is the inventor.

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**Overhead Wires.**—At a meeting of the Brighton Town Council last week, the Roads and Works Committee reported that at their meeting the letter from Mr. C. H. B. Patey, on behalf of the Postmaster-General, calling attention to the disadvantages under which the Post Office authorities are placed in having to carry all telegraph and telephone wires underground, whereas the Telephone Company and private contractors are permitted to erect overhead wires, was again submitted; and it was resolved that Mr. Patey should be informed that the committee, having regard to the absence of any authority in the corporation to prevent or control the erection of overhead wires by private companies or persons, were prepared to recommend the Council to permit the erection of such wires by the Post Office authorities, subject to such restrictions and conditions as the Council might be advised; and that the Town Clerk and the Corporation Solicitor be requested to prepare a draft of such conditions, and submit the same to the committee for approval. The recommendation of the Committee was adopted.

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**Personal.**—We announced last week that the firm of Messrs. Edmunds and Goolden, of Westminster and Halifax, electrical engineers, had dissolved partnership, and we are now requested to state that Mr. A. P. Trotter, B.A., Cantab., well known as the inventor of the dioptric system of light distribution which bears his name, has entered into partnership with Mr. W. T. Goolden, M.A., Oxon., and, with him, will continue the business of the late firm under the style of Goolden and Trotter.

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**The "Electra."**—The new cable steamer *Electra*, built and engined by Messrs. R. Napier and Sons, for the Eastern Telegraph Company, had an official test of her speed on the measured mile at Skelmorlie, on the 12th inst. She is a vessel of 1,150 tons, and measures 230 feet by 32 feet by 24 feet to the awning deck. The vessel is driven by a pair of compound surface condensing engines, of 1,250 horse-power indicated, steam being supplied by two single-ended steel boilers. At the trial on the measured mile a mean speed of 12·75 knots was obtained on four runs, which was considered most satisfactory.

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**The Cores of Electro-magnets.**—Makers of electrical instruments for current measuring and such like purposes will do well to read the remarks of Professor John Perry in the discussion on "Electric lighting for steamships," published in our current number. It is certainly a most difficult matter to obtain instruments which may be depended upon for correct readings for even a moderate period.

**The Calibration of Measuring Apparatus.**—We frequently have occasion to visit installations of electric lighting, and we sometimes find special forms of voltmeters and ampèremeters placed vertically against a wall probably for convenience in reading. To those of our readers who may not have noticed the fact, we would say that such instruments with pivotted needles generally give a lower indication when so fixed than when laid horizontally. As they are, we believe, usually calibrated in this latter position we need scarcely say that they should be so employed in actual use, or if fixed vertically, should be calibrated in that position. As an instance of how serious an error may easily be produced, we recently took down from its vertical position an instrument which was registering 48 ampères (another horizontally placed was indicating 60), and upon placing it in a horizontal position it immediately pointed to 60 ampères.

**Moribund Companies.**—The following are among the 300 companies respecting which the Registrar has given notice that at the expiration of three months, unless cause is shown to the contrary, their names will be struck off the register, and the companies dissolved:—Belgian Thermo-Electric Generator Company, Colonial, European and American Telegram Company, Improved Electric Telegraph Company, Indo-Australasian Telegraph Company, Trinidad Gutta Percha and Plantation Company.

**Balloon Steering by Electricity.**—The Russian Government, we learn, has ordered from a Paris balloon factory two elongated silk balloons, in order to experiment on their direction by electricity. The Italian Government has also ordered two silk balloons equipped with telephones, &c., for captive ascents.

**Secondary Batteries.**—"G. F.," in *Engineering*, gives the following extracts from a letter written by M. Gaston Planté to a friend in this country:—"I am happy to see that you are using with success some of my secondary cells for the lighting of your own house. I should tell you that you must not be discouraged if you meet with some difficulty in their use. The plates, far from deteriorating with age (like those to which artificial layers of peroxide have been applied, as in the various modifications of my couples which have been attempted), become penetrated, under electrolytic action, more and more deeply with peroxide, which unites with them perfectly, and their capacity consequently goes on increasing without there being any danger of the plates losing their solidity. It is of importance not to leave them too long without charging them, because their resistance is increased by rest, on account of the sub-oxides or salts formed, and they afterwards take much longer to charge. You will notice that in my 'Recherches sur l'Electricité,' I have not used the mischievous phrase that they 'store electricity.' On the contrary, I have said very distinctly that these cells do not directly store electricity; it is but the chemical work of the battery."

**Mr. Swan.**—According to the *New York World*:—"Joseph Wilson Swan, the electric light inventor, lives elegantly at Bromley, Eng., and is described as a handsome man, with a noble head set on a rather long neck—a distinguishing characteristic of the Swan family."

**Production of Copper in the States.**—Official statistics show that the total production of copper in the United States last year was about 150,000,000 pounds, against 115,500,000 in 1883, an increase of 30 per cent. The gain was largest in Montana, that territory having turned out 44,500,000 pounds, against 24,000,000 in 1883. The increase in the Lake Superior region was 8,800,000 pounds, and the Arizona 2,700,000 pounds.

**Telegraph and Telephone Wires.**—At the sitting on Thursday of the Select Committee of the House of Commons upon this subject, Mr. Hunter, the solicitor of the Post Office, submitted his summary of proposals of the Post Office for amending the existing law. Mr. Thomas Fletcher, telegraph engineer to the United Telephone Company, giving evidence, said the life of a wire in the metropolis was about five or six years. Subscribers to wires, if they had them placed underground, would have to pay very much more than overhead. Some of the wires had broken owing to the snowstorm of Sunday, but that was exceptional, as the snow attached itself unusually to the wires. If they had to place the wires underground it would prohibit telephone communication altogether.

## NEW COMPANIES REGISTERED.

**Gold Amalgmator Syndicate, Limited.**—Capital: £7,500 in £5 shares. Registered office, 15, New Broad Street. Objects: To acquire the patent rights for New Zealand, granted in respect of Barber's patent electro-amalgamating process for extracting precious metals from their ores by means of electricity. Signatories (with one share each): S. W. Smith, 4, Carlton Road, Tottenham; R. H. Dee, 125, Flaxman Road, Camberwell; W. Choat, 21, Vivian Road, Peckham Rye; J. Lichfield, 61, Leyspring Road, Leytonstone; E. Fickling, 36, Wilson Street, Finsbury; W. H. Waddington, 18, Billiter Street, E.C.; A. T. Angus, 69, Holland Road, Kensington. The signatories appoint the first directors, and are to act *ad interim*. Qualification: 50 shares. Remuneration: £100 per annum to the chairman, and £50 per annum to each other director. Registered 19th inst. by W. Lichfield, of Leytonstone.

**Portable Electric Safety Lamp Company, Limited.**—Capital: £100,000 in £5 shares. Registered office, Leadenhall Buildings, E.C. Objects: To purchase from Ernest Moreton, of 25, St. Margaret's Road, Brockley, the letters patent, No. 7439, dated 8th May, 1884, relating to electrical inventions, and to manufacture lamps and other appliances for electric lighting. Signatories (with one share each): Wm. Harvie and Wm. Johnston, Leadenhall Buildings; J. H. A. Drought, 15, Kensington Gardens Terrace; W. H. Dunn, 27, Bishopsgate Street; R. Hewlett, 31, Essex Street, Strand; M. H. Isaacs, 39, Lombard Street; H. Elford, 364, New Cross Road. The signatories are to appoint the first directors. Qualification: 100 shares. Remuneration: £1,000 per annum. The purchase consideration is £70,000, of which £33,000 is payable in fully paid shares. Registered 20th inst. by Mr. A. Doubble (registration agent) 40, Fleet Street, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**South of England Telephone Company, Limited.**—An agreement, dated 21st inst., which was filed on the 23rd inst., stated that Mr. Robinson Kendal agrees with the company that he will procure to be allotted or transferred to every person who shall subscribe for preference shares of the company's capital one fully paid ordinary share for each preference share subscribed.

**Varley Electric Patents Proprietory, Limited.**—An agreement, dated 7th inst., and filed with the document of this company on the 23rd inst., relates to the adoption by the company of an agreement of 13th January for acquiring various letters patent of Mr. Frederick Henry Varley and others, for electrical inventions.

**Electric Lighting Supply and Fitting Company, Limited.**—The annual return of this company, made

up to the 4th inst., was filed on the 17th inst. The nominal capital is £20,000 in £10 shares. 125 shares have been issued as fully paid, and 482 shares have been subscribed for, and upon these the full amount has been called up, the calls paid amounting to £4,820, and considered as paid to £1,250. Since the last return the paid up capital has increased £282.

At a meeting of the company held at 28, York Street, Westminster, on the 4th, it was proved to the satisfaction of the meeting that, by reason of its liabilities, the company could not continue its business, and it was resolved that it should be wound up voluntarily, and Mr. Henry Brockholes Thomas was appointed liquidator.

**Swan Electric Light Company, Limited.** — The return of this company, made up to the 16th of May, 1884, was filed on the 20th inst. The nominal capital is £100,000 in £10 shares. 7,500 shares have been subscribed for, and 2,500 have been issued as fully paid to Mr. J. Wilson Swan, as part of the purchase money. Upon the subscribed shares £5 has been called, the total calls paid being £37,500, and considered as paid £25,000.

## CITY NOTES, REPORTS, MEETINGS, &c.

### "Pilsen," "Joel," and General Electric Light Company, Limited.

AN extraordinary general meeting was held at the company's offices, St. Stephen's Chambers, Telegraph Street, E.C., on Thursday, Sir Rawson W. Rawson, K.C.B., presiding.

Mr. Gregory, the secretary, having read the notice convening the meeting,

The Chairman said: The report of the directors having been circulated, and the notice explaining distinctly the two main objects with which the present special meeting is called, I do not think it necessary to enter into any further matter to detain you unnecessarily; and, therefore, the first resolution that I have to propose for your adoption is, "That the report of the directors dated March 17th, 1885, be received and adopted." This is a special and extraordinary meeting for the purpose of reporting the completion of the work assigned to us at the last general meeting, and to request your confirmation of the appointment of Mr. Whately, which the three directors appointed at that meeting were authorised to make. We have taken the opportunity of laying before all our shareholders what we have done in the matter of carrying out their wishes, and the present condition and the hopes of the directors, in the briefest form, and I would lay before you this resolution as the complement of our action.

Mr. Tritton seconded the resolution, which was carried unanimously.

The Chairman then moved, "That the appointment by the three directors elected on the 28th of August, 1884, of Mr. George Levinge Whately to be a director be approved, and that he have the same remuneration as the other directors."

Mr. E. Dennis seconded, and the motion was agreed to without dissent.

The Chairman, in reply to a shareholder, said the liabilities of the Company at the present time were *nil*; they had liquidated all liabilities with the exception of rent not yet due. All that they could realise from the sale of stock and machinery, and by gathering in the debts due to them, would be for the benefit of the shareholders. The view the directors took was that, with a prospect of a change in the legislation with regard to street lighting, for which their lamp was specially adapted, they ought to wait and see what improvement took place in electric lighting at an early period, and how far they could dispose of their patents or utilise them to the advantage of shareholders. This was not the moment for shutting up entirely and sell patents which at the present time were worthless, but just simply to hold on at the very lowest expense without any unnecessary charge.

This terminated the business of the meeting.

### German Union Telegraph and Trust Company, Limited.

THE fourteenth ordinary general meeting of this company was held at 66, Old Broad Street, E.C., on Wednesday, Sir James Anderson, Chairman of the company, presiding.

Mr. Payton, the secretary, having read the notice convening the meeting, and the minutes of the previous meeting having been adopted,

The Chairman said, before moving the resolution that the report be adopted, he had one or two remarks only to make. The first was one that was satisfactory in the extreme. The Berlin Company had, as they would see by the accounts, £50,000 of reserve, and in addition to that, £18,000 of unissued capital, making 68,000 sovereigns in hand upon a capital of £300,000. Without a large reserve, he asserted, no telegraph company could be considered solvent. The next remark he had to make was, that a decrease in the number of words transmitted had produced a diminution in the receipts, which was not compensated for by the additional number of messages sent. This was a matter that was coming to the front very fast in telegraphy. Codes were being adopted having no relation to any language, except that they were syllabic combinations of two letters, and this was making a serious difference in the receipts of every telegraph company. The merchants had taken every advantage, and he thought that in a short time the companies would have to cry out. He mentioned this matter because they were all considering it, and the Indian Government and the Post Office also had the matter before them, and he had no doubt that at the conference in August it would be discussed. A rather smaller dividend would be paid than that last year, but considering the opposition of Atlantic cables, and the depression of trade, he thought they had arrived at a very satisfactory result. The German Union Company, with its large reserve, stood as good a chance of remaining firm as any telegraph company he knew. He moved the adoption of the report and accounts, and the payment of a dividend of 5s. 6d. per share, making, with the interim dividend of 5s. 9d. per share, a total distribution for the year of 11s. 3d. per share, or at the rate of £5 12s. 6d. per cent. per annum.

Mr. Erichsen, a director, seconded.

Mr. Griffiths asked if the new cables laid between this country and the United States were likely to affect the German Union traffic to America *vid* Valentia.

The Chairman referred to the report of the Berlin Company, which stated that the Bennett-Mackay cables had deprived that company of a fraction, though a very small one, of the traffic. It was pointed out that the line laid from Valentia to Emden, in Germany, gave such rapid communication with America, that the company was likely to retain, practically, the whole of the traffic; and the directors, said the Chairman, would always do their best to do so, although competition and opposition and lower rates "could not be good."

The motion for the adoption of the report was then put and carried unanimously.

Count Oscar von Reichenbach was reappointed a director, and the auditor, Mr. Henry Dever, was also reappointed.

Mr. John Pender, M.P., in moving a vote of thanks to the chairman and directors, remarked that the matter of the coding system was one which would require to be looked into by all the different companies. While the public, as a rule, were entitled to do the very best they could to cheapen the system, on the other hand the directors must take care that the shareholders' interests were duly and properly protected.

The vote was accorded, and the meeting terminated.

### Direct Spanish Telegraph Company, Limited.

THE report of the directors for the half-year ended 31st December, 1884, is as follows:—

"The annexed accounts for the half-year ended 31st December, 1884, show a balance to the credit of profit and loss of £4,486 0s. 9d. The traffic receipts show a falling off of £316 17s. 4d. as compared with the corresponding half-year of 1883. This decrease is principally due to the quarantine regulations in Spain during the prevalence of cholera in the Mediterranean.

"The original Bilbao cable, as mentioned in the last report, broke down on the 17th July, and continues interrupted. The new Bilbao cable and the Marseilles-Barcelona cable have continued in perfect working order.

"After applying £335 14s. 7d. to close the preliminary expenses account, there will remain a balance of £4,150 6s. 2d., of which it is proposed to put £4,003 14s. 2d. to the reserve fund, which will then amount to £5,000, and to carry £146 12s. 0d. to the next account.

"On the 14th of January the directors issued the following circular to the shareholders; since then another break has occurred in the original Bilbao cable:—

"'Since the last half-yearly report was issued, in which it was stated that the directors did not contemplate restoring the original Bilbao cable at present, another break is known to have taken place in it, and the board have, after careful consideration, come to the conclusion that a thorough examination of the whole cable is necessary.

"'This, therefore, will be undertaken as soon as the season permits, and it is hoped that the exact amount required for the reinstatement of the cable may be known before the half-yearly meeting in September. In the meantime, the reserve fund being practically exhausted, the board are advised by eminent counsel that no dividend can properly be paid upon either class of the company's shares until adequate provision has been made for the re-instatement.

"'While they much regret to announce that the usual dividend cannot, under the above circumstances, be paid next March upon the preference capital, the directors would remind the preference shareholders that their dividend for the past half-year, and any further dividends which may have to be withheld from them, will be payable (under the terms on which the shares were issued) out of the first available profits of the company.

"'The new cable continues in perfect working order, and the

revenue for the past half-year was, as nearly as possible, the same as for the corresponding half of 1883.

"'Since the last general meeting, Mr. Bannatyne and Mr. Scott, in consequence of engagements with other companies, have resigned their seats at this board.'"

## Montevidean and Brazilian Telegraph Company, Limited.

AN ordinary general meeting was held at the company's offices, 2, Tokenhouse Buildings, E.C., on Wednesday, Sir Thomas Gore Browne, K.C.M.G., C.B., presiding, when the whole of the business transacted was the passing of the report of the directors, given under, and the re-election of the retiring director and auditor:—

"The company's percentage of the gross earnings of the Western and Brazilian Company for the year is estimated at £1,860; a reduction of £380 12s. 7d. as compared with the preceding year, or of about £900 as compared with 1882. The directors are informed that this serious diminution in the company's income arises mainly from the great reduction in rates which competition has compelled the Western and Brazilian Company to adopt.

"The balance to the credit of revenue account amounts to £582 9s. 2d., out of which £500 has to be set aside for redemption of debentures, leaving a net balance of £82 9s. 2d., which will not admit of the payment of any dividend, and will be carried forward to next account."

**The Eastern Extension, Australasia, and China Telegraph Company, Limited.**—The directors state that the accounts to the 31st of December last show, subject to audit, a profit balance of £110,123, after payment of three interim dividends and a bonus of 2s. per share for the first half-year, and charging £42,767 against revenue during the year on account of cable renewals. They now propose to pay on the 30th of April the usual dividend of 2s. 6d. per share, together with a bonus of 2s. per share (both free of income tax), making with previous distributions a total payment of 7 per cent. for the year 1884. The balance of £33,876 has been carried to the reserve fund, which now stands at £510,649.

The company announces the numbers of 433 five per cent. debentures (1880 issue) of £100 each, which have been drawn for payment at par on May 1st at the Consolidated Bank, 52, Threadneedle Street, after which date interest on them will cease.

**The Liverpool Electric Supply Company, Limited.**—The directors state in their annual report that the profits of the 12 months ended December 31st, 1884, enable them to recommend a dividend at the rate of 5 per cent. per annum, after providing for all contingencies, and setting aside £150 for reserve fund. The dividend for the previous year (1883) was also 5 per cent. During the last few months the number of electric lamps supplied from the company's central station in Elliot Street has been very largely increased, the advantage of which will be felt in the augmented rental receipts of the current year.

**The Anglo-American Telegraph Company, Limited.**—The directors, after placing £37,500 to the credit of the renewal fund, recommend an interim dividend, for the quarter ending March 31st, of 4s. per cent. on the ordinary and 8s. per cent. on the preferred stocks, less income tax, payable on May 1st to the stockholders registered on March 31st.

**The Eastern Telegraph Company, Limited.**—This company announces the payment, on April 14th, of a dividend of 3s. per share on the preference shares, less income tax, for the quarter ending March 31st, and an interim dividend of 2s. 6d. per share on the ordinary shares, free of income tax, in respect of profits for the quarter ended December 31st.

**Swan United Electric Light Company, Limited.**—A call of 10s. per share has been made on the partly paid shares of this company, payable 5s. on May 1st next, and 5s. on July 1st next.

**The River Plate Telephone and Electric Light Company, Limited.**—This company notifies that coupons due April 1st next will be paid, less income tax, on and after that date at the Alliance Bank, Limited, Bartholomew Lane, E.C.

**Irwell India Rubber and Gutta Percha Works, Limited.**—Vice-Chancellor Bacon has fixed April 2nd for the appointment of an official liquidator of this company.

**Great Eastern Steamship Company, Limited.**—Mr. Justice Chitty will appoint an official liquidator for this company on the 1st prox.

## TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 20th were £2,362, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

## NEW PATENTS—1885.

3475. "Telephone receivers." G. H. BASSANO, A. E. SLATER, F. T. HOLLINS. Dated March 18.

3499. "Ohmmeters or apparatus for measuring electrical resistances." M. A. ANDREOLI. (Communicated by L. Maiche.) Dated March 18.

3505. "Electrical cartridges." S. RUSSELL. Dated October 22, 1884. (*Complete.*)

3518. "Holder for incandescent electric lamp." A. KHOTINSKY. Dated March 18. (*Complete.*)

3524. "Regulation of dynamo-electric generators." T. J. HANDFORD. (Communicated by F. J. Sprague.) Dated March 18.

3525. "Apparatus for distributing and utilising electricity." R. P. and J. S. SELLON. Dated March 18.

3537. "Electrical lamp holders." A. SWAN. Dated March 19.

3553. "Electrical connections." J. ENRIGHT. Dated March 19.

3564. "Arrangements of telephonic apparatus." S. P. THOMPSON. Dated March 19. (*Complete.*)

3588. "Current and voltmeter or volt regulator." W. E. HEYS. (Communicated by M. Berry.) Dated March 20.

3599. "Dynamo-electric machines." A RECKENZAUN. Dated March 20.

3613. "Electro optical night signal apparatus." O. IMRAY. (Communicated by M. Sauer.)

3616. "Application of the electrical light to gymnastic appurtenances." J. HARRISON. (Mdme. Lilla.) Dated March 20. (*Complete.*)

3619. "Protection for suspended wires." E. TOMLINSON. Dated March 20.

3625. "Supports for the shades and bulbs of incandescent electric lamps." A SWAN. Dated March 20.

3671. "Electric cartridges and electric primers therefor." S. RUSSELL. Dated March 21.

3678. "Voltaic elements." C. P. ORME. Dated March 21. (*Complete.*)

3679. "Dynamo machines." M. IMMISCH. Dated March 21.

3730. "Manufacture of electric incandescence or glow lamps." R. W. WILSON. Dated March 23.

3744. "Regulators for dynamo-electric machines." J. H. JOHNSON. (Communicated by A. de Méritens.) Dated March 23.

3764. "Electric fuses." J. MACNAB, D. HICKIE. Dated March 24.

3765. "Filaments or carbons for incandescent electric lamps." G. DAVIDSON, R. C. JACKSON, J. B. DUNCAN. Dated March 24.

3769. "Filaments for incandescent electric lamps." G. DAVIDSON, R. C. JACKSON, J. B. DUNCAN. Dated March 24.

3789. "Electrical signalling apparatus for hotel and analogous purposes." B. J. B. MILLS. (Communicated by F. E. Lyster and G. J. Schermerhorn.) Dated March 24. (*Complete.*)

3798. "Electric batteries." W. R. LAKE. (Communicated by H. L. Brevoort and J. L. Roberts.) Dated March 24.

3805. "Electric governors." J. SWINBURNE. Dated March 24.

3813. "Electric signalling apparatus." F. B. HERZOG. Dated March 24. (*Complete.*)

3816. "Signal apparatus for telephone systems and other currents." B. J. B. MILLS. (Communicated by F. E. Lyster and G. J. Schermerhorn.) Dated March 24.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

2059. "Improvements in arc lamps." J. BROCKIE. Dated January 24. 6d. Refers to an improved method of arranging the circuit and duty of a regulating relay in an arc lamp, and also to an improved method of working relays of ordinary arrangement and duty common in such apparatus. The inventor arranges the relay circuit in series with that of the magnet or solenoid which actually works or controls the feeding mechanism. He arranges the relay armature when it is attracted by its magnet and so makes contact, to cut out the relay coil or part of it; this of course has the immediate effect of strengthening the current in the remaining operating coil, and therefore it performs its regulating duty (such as lifting a brake off the last wheel in the lamp train, or directly influencing a brake or clip which grasps the carbon holder rod). Immediately, however, the relay makes contact as above explained, the relay magnet is momentarily demagnetised (as it is cut out or short circuited), and the contact is therefore again broken, this operation being repeated until the arc becomes of its pre-arranged resistance by the approach of the carbons.

2383. "Improvements in galvanic batteries, and in obtaining commercially valuable residual products from the employment of

such batteries." F. H. GOSSAGE. Dated January 30. 2d. Consists in the construction of a battery in which the elements zinc and carbon are employed. The zinc is placed in a porous cell or chamber, with a solution of caustic soda or of caustic potash, and the carbon in a depolarising solution such as chromic acid. The residual products obtained by the employment of this battery are zincate of soda or of potash and oxide of chromium when the solution of chromic acid has been used, and these products may be employed for purposes useful in the arts.

2922. "Improvements in signalling apparatus." J. FARQUHARSON and D. W. LANE. Dated February 7. 6d. Relates to the apparatus described in the number of the REVIEW for February 7th.

2923. "An improved speed indicator." J. FARQUHARSON and D. W. LANE. Dated February 7. 6d. Relates to the apparatus described in the number of the REVIEW for December 18th, 1884.

3797. "An improved belt for administering electricity for medical purposes." J. E. SPRATT. Dated February 22. 6d. Consists of any number of terminals insulated from each other with wires connecting them with a medical coil so as to receive primary—secondary—or alternating currents either from the coil or the current from the battery direct to two or more of the terminals attached to the belt, so connected to be in contact with two or more of the terminals or any part of the belt.

4332 "Improvements in dynamo electric machines." R. E. B. CROMPTON. Dated March 3. 6d. The objects of the invention are:—1st. The better communication of the driving strain from the driving spindle or axle to the armature core and coils or winding. 2nd. The obtaining an intense magnetic field of force through which the armature coils or winding moves, and hence obtaining high electromotive force with comparatively few turns of winding and slow surface speed of the armature, by so proportioning and arranging the iron composing the armature core, and the copper conductor forming the winding, that the radial depth of this iron core may be as great as possible. 3rd. The arranging of the winding and its insulation as to allow of the free access of a ventilating current of air to every part of its surface, and the providing this ventilating current by simple means. 4th. The simplification of the winding so that every part of it is readily accessible for examination, repair or renewal. The improved armature consists of an iron ring core formed preferably of a large number of separate rings or washers stamped out of soft annealed sheet iron, these washers are mounted on longitudinal spokes or radial bars made of non-magnetisable metal and held in such a manner that the central hub carrying these radial bars can be withdrawn leaving the radial bars on which are mounted the washers attached firmly to the latter, this withdrawal of the central hub or hubs (as the case may be) greatly facilitates the winding of the armature coils on to the core. Figs. 1 to 4 show one

FIG. 1.

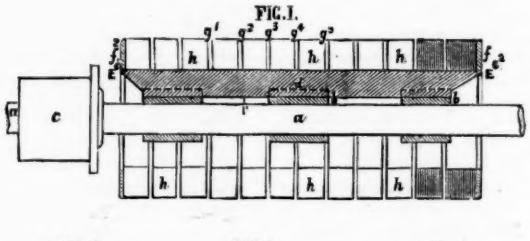



FIG. 2.

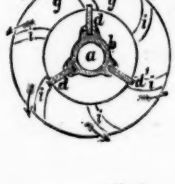
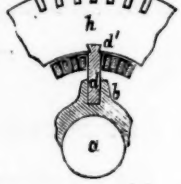



FIG. 3.

FIG 4.




method of mounting the core. Fig. 1 shows a longitudinal section through the spindle, hubs, radial bars and core. Fig. 2 shows a sectional end view through a plain ring or "Gramme" form of core. Fig. 3 shows a sectional end view through a portion of the same to a larger scale, and shows a portion of the winding in position. Fig 4 shows a sectional end view through an indented ring or "Pacinotti" form of core with portion of the winding in position. *a*, *a*, is the spindle; *b*, *b*, the hubs; *c*, the commutator; *d*, *d*, the radial bars, $d^1$ the dovetail shaped projections fitting into the corresponding notches in the core rings, *h*, *h*, *h*. Figs. 2, 3 and 4 show clearly the mode in which the inner edges of the radial bars, *d*, *d*, are carried by the grooves or keyways in the hub, *b*. To mount the armature coils in the first instance the radial bars, *d*, *d*, are first placed in order in their grooves, in the hub or hubs, and then one end washer, *f*, made thicker than the others, is slid over the bars, the dovetail notches sliding down the corresponding projections, $d^1$, $d^1$. This first washer, *f*, is prevented from sliding right over the ends of the radial bars by their being slightly upset or rivetted over at *e*, the notches in the washer, *f*, being made larger at the outer side than at the inner one, as shown by the sloping lines at $e^2$. The remainder of the washers are then slid on in order, being insulated from one another by asbestos paper or by coating them with a suitable insulating material. At regular intervals, as shown at $g^1$, $g^2$, $g^3$, $g^4$, $g^5$, &c., the washers may be spaced from one another by strips of material which must also insulate them from one another, and thus leave radial ventilating channels or spaces as shown in fig. 2 where *i*, *i* are the spacing strips and *g*, *g* the ventilation channels, after all the washers have been put on so as to form a core of the required length, the last washer put on must be a thick one made similar to the first one, *f*. This is shown at $f^2$, the ends of the radial bars are then rivetted down on to the last washer, $f^1$, as shown at $e^1$. The spindle and hub, *a* and *b*, can now be withdrawn and the core will be left having the radial bars firmly attached to it as radial strips projecting inwards from its inner surface, but in no way interfering with the process of winding on the coils.

5757. "Insulating supports for electric wires." B. PITT. Dated April 1. 2d. This insulator is made corrugated, or with a series of ribs or edges for the bound wire or conductor to rest against, thus presenting at the point of contact a minimum of surface, thereby effecting a great saving of the electric current passing through the wire by diminishing the possibility of leakage at the insulator.

9607. "Improvements in electric bell pushes, contact makers, or indicators." W. A. LEIPNER and C. BROTHERHOOD. Dated July 1. 6d. Consists of an electro magnet in front of one of the poles, of which an armature of soft iron, or any armature capable of being attracted by a magnet, is mounted on a spring free to vibrate, and which armature and spring are capable of being adjusted by a screw. On the armature is hinged or fixed rigidly a needle or pricker, or blunted pointed piece of metal, either round or of any other section. This needle or bar fixed to the armature passes through the knob of the push. When the knob is pushed in it completes the circuit just the same as any push does. The action is as follows:—When the knob is pushed the circuit is completed; therefore, if the bell is in proper working order, it will ring, and, through ringing, it causes the current, as is well known, to be rapidly broken and made. This interrupted current in passing round the coil of the electro magnet will magnetise it every time the bell contact is made. It will be seen that there then must necessarily be a vibration of the adjusted armature and needle. This is felt on the finger of the operator as a succession of small blows or prickings, thus indicating to him that the bell is ringing. Should there be any short circuit or bad connections, the bell failing to operate, no vibrations can be given on the armature and needle, showing to the operator by their absence the presence of a short circuit, and demonstrating fact of bell not ringing.

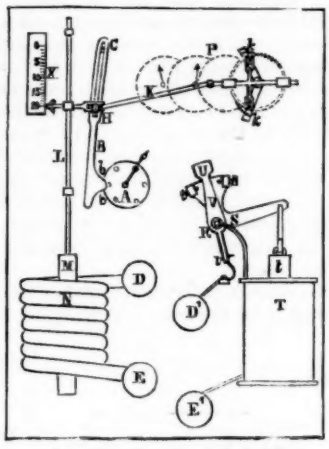
13682. "Improvements in the art of telephony." J. N. MCINTIRE. Dated October 16. 6d. The inventor adapts a tube to the transmitter box front and provides its outer end with a sort of flared throat piece, or concentrator, the usual box cover or lid being formed or provided with a tubular orifice (from which the said tube extends outwardly) instead of having the commonly employed flaring mouth-opening usually talked into by the speaker.

14779. "Improvements in dynamo-electric machines." W. R. LAKE. (Communicated from abroad by L. Bollmann, of Vienna.) Dated November 8. 6d. Relates to dynamo-electric machines not having iron in the rotating armatures, and has for its objects, firstly, to produce a powerful induced current by means of a disc revolving between field-magnets, and consisting of peculiarly arranged radial strips of copper connected by other strips running in circular directions to form circuits for the current to circulate many times in opposite directions through the said radial strips; secondly, to arrange the said connecting strips in relation to the field-magnets in such a way that useful currents are induced in the same as well as in the radial ones; thirdly, to so arrange the field magnets that they will act with their north poles on the one side and with their south poles on the other side of the armature; fourthly, to arrange the armature and commutator in such a manner that the said strips can be connected in various ways, to act more or less in series or in parallel to vary the electromotive force of the current produced; and, fifthly, to so construct the frame of the machine that the armature and the shaft can be easily removed, without taking the frame apart.

14933. "An improved construction of box, trough, or cell for galvanic batteries." T. J. JONES. Dated November 12. 8d. Has for its object a simple, inexpensive, and permanently water tight construction of wooden trough or receptacle of which the various parts are securely held together without the use of any metallic fastenings.

15069. "An electric meter." A. P. TROTTER. Dated November 15. 4d. The fig. is a front view of the apparatus, the front of the case being removed to show the mechanism behind; A, is a disc fixed on the arbor of the minute hand of the clock, and having a number of equidistant studs projecting from it, so that as A revolves, these studs act successively at equal intervals on the curved inclines, *b*, of a lever, B, which is suspended from a fulcrum, C. In the lever, B, there is a slot extending a certain distance from its fulcrum, and having engaged in it the pin, H, of a connecting rod, K. The pin, H, is also engaged in the slot of an arm projecting from a vertically sliding rod, L, that is attached

to the core, M, of a solenoid, N. This solenoid has its coil connected in the circuit conductors, D, E, or in a branch of the circuit, the current through which is to be measured. The core, M, is urged upwards by a counterweight or adjustable spring, not shown. The connecting rod, K, works pawls, *k*, acting on a finely toothed ratchet wheel, O, geared with a counter, P. The greater




the attractive power of the solenoid, N, on its core, M, the farther is the pin, H, moved from the fulcrum, C, of the lever, B, and consequently the greater is the movement given to the pawls, *k*, and to the counter, P. A scale, X, serves to indicate the attractive force acting on M. In the remontoir apparatus, R is the spindle of the weight or spring barrel, on which is fixed the lever, S, connected to the core, *t*, of a solenoid, T. On the lever, S, is mounted the tumbling weight, U, on an arm, V, which can oscillate freely between adjustable screw stops. When the lever is in the position shown, the tail, *v*, makes electrical contact with a spring, causing an electrical current to be transmitted from a shunt, $D^1$, $E^1$, of the main circuit through the coil, T, which attracts its core, *t*, downwards, moving the lever, S, and so turning partly round the spindle, R, and thereby partly winding up the clockwork. When the lever, S, has thus been moved a certain distance, the weight, U, tumbles over to the right breaking contact at *v*.

15355. "Improvements in electric locomotives or electromotor engines." F. H. DANCHELL. Dated November 21. 6d. The object of the present invention is to increase the efficiency of certain motors by producing or ensuring more perfect conduction of the current from the current conducting rail or rails to the motor by means of an improved form of elastic contact wheel, and by producing or ensuring more perfect application of the power thus received, and to be given out by the motor, by means of elastic self-acting adhesion producing appliances.

15544. "Improvements in electricity gauges." J. GOODMAN and H. M. GOODMAN. Dated November 25. 4d. Has relation to means for estimating the amount of electric energy that traverses a given circuit, whether a direct or derived circuit, and it consists in the construction and novel arrangement of certain devices for the purpose.

15713. "Improvements in primary voltaic batteries." D. G. FITZGERALD and T. J. JONES. Dated November 28. 2d. The object of the invention is to diminish the cost of working primary voltaic batteries and to obviate the inconvenience and loss of efficiency due to the "efflorescence" and "creeping" of crystalline salts, such as are ordinarily employed or produced in such batteries. This object is effected by substituting for zinc, as the positive element of a primary battery, the metal lead in a porous or spongy condition; the electrolyte being a solution of some acid (such as sulphuric or phosphoric acid) which forms with lead an insoluble salt, from which the metal is economically recoverable.

15772. "Improvements in voltaic batteries." D. G. FITZGERALD and T. J. JONES. Dated November 29. 6d. Consists in a method of manufacturing negative elements for primary voltaic batteries, applicable also as negative elements (anodes in charging) for secondary batteries. In carrying out the invention the inventors obtain plates, slabs, or other forms of oxide of lead, from a pasty mass containing this substance (which may advantageously be in admixture with finely divided lead, which subsequently becomes oxidised), and these plates, &c., when dry and hard, they convert into dense, conductive, peroxide of lead by means of electrolysis. They usually enclose and compress the pasty mass of oxide of lead (or other compound convertible into peroxide of lead), together with a conducting plate, tang, strip, or wire, which serves to effect the electrolytic conversion of the oxide of lead, between plates or slabs of non-conducting material, such as porous earthenware, plaster of Paris, wood or ebonite, which virtually constitute, or may take the form of, a mould. When, as in the last instance, the non-conducting material is also non-porous, one at least of the plates between which the lead compound is enclosed must be perforated with holes or apertures in order to allow of the electrolytic action whereby the lead oxide is converted into lead peroxide. This conversion is effected by means of an electric current from a dynamo machine or other suitable source of electricity, and of an electrolyte (preferably a solution of sulphate of magnesia) in which the mould and its contained conductor and material to be converted into lead peroxide constitute the anode, opposed to any suitable cathode, such as a plate of lead covered with oxide of lead. When the conversion into lead peroxide of the material within the mould is complete, the non-conducting plates or slabs (or one of them only) may be removed, and the conducting plate or strip, when of non-oxidisable material, such as platinum, may also be removed (excepting in the case when it is embedded in the substance of the plate of peroxide, and is intended to serve as a permanent contact piece), and the lead peroxide is left in the form of a plate, which, if the operation has been properly carried out, is sufficiently dense and coherent (at least in the case of plates of moderate dimensions), even when both of the non-conducting plates have been removed, to bear handling, and sufficiently conductive to serve as a voltaic element.

## CORRESPONDENCE.

### Ball's Dynamo.

In your remarks on my letter which you published in the ELECTRICAL REVIEW of March 14th, you stated that it would have been much better had I given simple facts in regard to Ball's machine instead of mere observations, or at least your words were to this effect. I have much pleasure, therefore, in submitting some tests I made on the 20th inst. with a Gramme machine, and which I think will quite bear out my observations already given to your readers.

*Tests made with Gramme Machine March 20th*, 1885.

The field-magnets in each case were separately excited with a current of 10 ampères.

No. 1. In this experiment the lower magnet bar was taken out of the machine, so that the Gramme acted as a simple unipolar dynamo.

No. 2. In this experiment the lower magnet bar was replaced, so that the dynamo acted as an ordinary Gramme machine.

| No. of test. | Speed per minute. | Current. | E.M.F. at brushes. | Resistance in external circuit. | Output in watts. |
|---|---|---|---|---|---|
| No. 1 | 1250 revs. | 14 ampères | 90 volts | 6 ohms | 1260 |
| No. 2 | 1250 revs. | 20 ampères | 150 volts | 6 ohms | 3000 |

From these figures it will be seen that the mere *fact* of introducing the second opposite pole, as is done in all dynamos, excepting those of the Ball type, renders the *out-put* nearly 2·4 times as great as when the

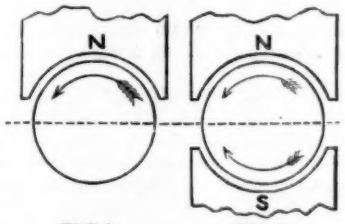



FIG. 1 FIG. 2

dynamo is acting as a simple unipolar machine. We might just as well argue that a single acting engine is as good as a double acting engine, as argue that the Ball machine is as good as a Gramme. It seems to me that the current generated by the armature of the unipolar machine may be represented by fig. 1, while that of the ordinary dynamos may be seen in fig. 2.

To return to the analogy with steam engines, we know that the double-acting engine uses more steam than the single-acting engine. But then the former gives out so much more work for the *size* of engine and *cost* of construction in comparison with the latter. Now this is precisely the same in regard to the two dynamos—the unipolar and the bi-polar. In Ball's machine we have two armatures, both *single acting*, if I may be allowed to use the term, while in the ordinary Gramme we have one armature *double acting*.

I do not dispute for a moment that the Ball machine is an *efficient* machine; it may be so, but it does not alter the case one atom, that is so far as my former arguments are concerned. The weight of the machine has nothing whatever to do with the question. We have before us the one simple *fact* that the introduction of the second opposite pole piece increases the *out-put* of the armature or machine nearly 2·4 times that of the same armature when rotated only before a similar single pole piece. It is just possible that this 2·4 may be a constant for the introduction of this second opposite pole with other dynamos. However, I hope those of your readers who have more time at their disposal than I have, will find out whether this is so. As far as I am concerned, I think the figures given fully enable me to still adhere to my opinion gathered by observation, viz., that at whatever price the Ball machine can be made, a more efficient Gramme can be made at about half this price. I only regret that absence from home will not enable me to continue this interesting discussion; but I must leave this to those who are far more able to go on with it than

**Charles Lever.**

Bowdon, Cheshire, *March 23rd.*

[We have never argued that the output of a machine with one pole-piece would be so great as with two, and so far as compactness is concerned, the latter would doubtless have an advantage for a given output. The question of price we will leave to those who can give exact figures, when it is just possible that Mr. Lever may modify his views. Is our Correspondent quite sure that the figures as quoted in the third, fourth, and fifth columns of his table are correct, as they do not appear to agree amongst themselves? Were some calculated or were all observed? The diagram No. 1 sent by Mr. Lever does not represent the current flowing in the armature of the Ball machine, this current being the same in both halves, only of course of less strength than that shown by the second diagram. We have recently heard that these machines gave surprising results in some official tests made after the close of the Philadelphia Exhibition, but we have not yet received particulars.—EDS. ELEC. REV.]

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### Dynamo Winding.

My attention has only recently been drawn to some remarks of Captain P. Cardew, referring to an article of mine in the ELECTRICAL REVIEW of February 21st, 1885.

I understand from the captain's remarks that he wishes to extend my formulæ by adding three corollaries when R = $r$, which is frequently very nearly the case.

Take, for instance, two similar dynamos, the one having a shunt field-magnet circuit, and the other with its field-magnet in series; the resistance of the armatures and all the other accessories being the same.

Then Capt. Cardew, firstly, says that the total internal work is the same; secondly, that the difference of potential at the terminals is the same; and thirdly, that the electromotive forces of the machines have the proportion of L + R to L + $r$. But neither of these propositions are correct, for in the shunt machine the work expended in both the field-magnet and the armature would be greater than that expended in the series machine; unless, indeed, "$r$" was great to "L," which should never be the case. Also, the difference of potential could be the same only when $r$ = L, and would always be greater in the shunt machine, when, of course L was great to $r$. Neither would it be at all possible to express the electromotive forces of the two machines by the proportion given by Capt. Cardew.

I can, therefore, only repeat what I have distinctly proved in my first paper on this matter, "to which I would ask Captain Cardew to refer." That in designing similarly-shaped machines with differently-wound field-magnets, it is necessary that the armatures should also have different resistances, and that the proportion of the resistances of the armatures should agree with the formula I have given as far as irregularities in the insulation of the conductor will permit.

In the case of changing the field-magnet from series to shunt-circuit in a dynamo that is already in use, it would, of course, be possible (in a rough way) by re-adjusting the speed to obtain, "in some cases," the same result in the outer circuit, "but not within the dynamo."

But in the case of a makeshift arrangement, I would ask why should it be necessary to re-wind the dynamo at all?

**W. Moon.**

*March 18th.*

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### Induction and Conduction.

In your issue of February 28th, Mr. Willoughby Smith makes an indirect thrust at some "sincere propounder" of certain theories. As sincerity is considered a merit, will you allow me to suggest that Mr. Smith should condescend to honour the individual with a name. We should then have the opportunity of judging. Perhaps the two theories do not involve the same phenomena, or it may be that the "sincere propounder's" theory involves phenomena which in reality exist, but which were omitted by Mr. Willoughby Smith. For instance, Mr. Smith makes no allusion to the inverse current on "charging" in his experiment, and neither does he mention the direct current on "discharging." I am under the impression that these secondary currents are inseparable from any electric or magnetic change.

**E. L. Voice.**

49, George Street, N.W.,
*March 21st*, 1885.

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### Amperes and Watts.

Can you inform me how much battery power is required for 2½ watts?

Also 1 ampère.

**J. C. Acton.**

39 and 40, Smallbrook Street,
*March 24th*, 1885.

[Yes: An electromotive force of 2½ volts through a resistance, including that of the battery, of 2½ ohms will produce 1 ampère, and 1 ampère multiplied by 2½ volts = 2½ watts.—EDS. ELEC. REV.].

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### Coils of an Arc Lamp.

I should be very much obliged if you, or any of your readers, through the medium of your journal, would inform me of the number of ohms resistance that the shunt and the main circuit coils would have to be. The coils would have to have a lifting force of one ounce, the E.M.F. used would be 20 volts, and the current 1 ampère.

**F. B. Fawcett.**

Eastfield Park, Weston-super-Mare,
*March 23rd*, 1885.

[Arc lamps are usually employed with an electromotive force of 50 volts or so, and a current of 10 ampéres or more, but the apparatus mentioned above is probably for a special purpose. No doubt some of our readers will give the desired information.—EDS. ELEC. REV.]

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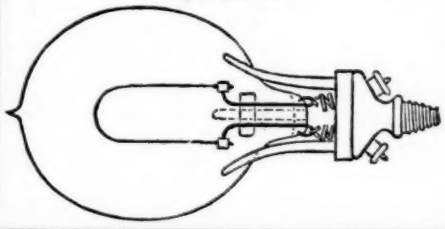

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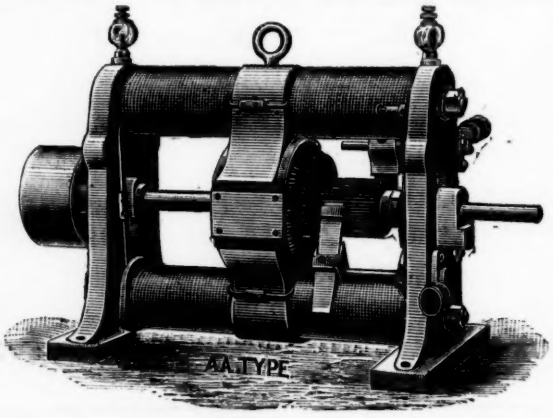


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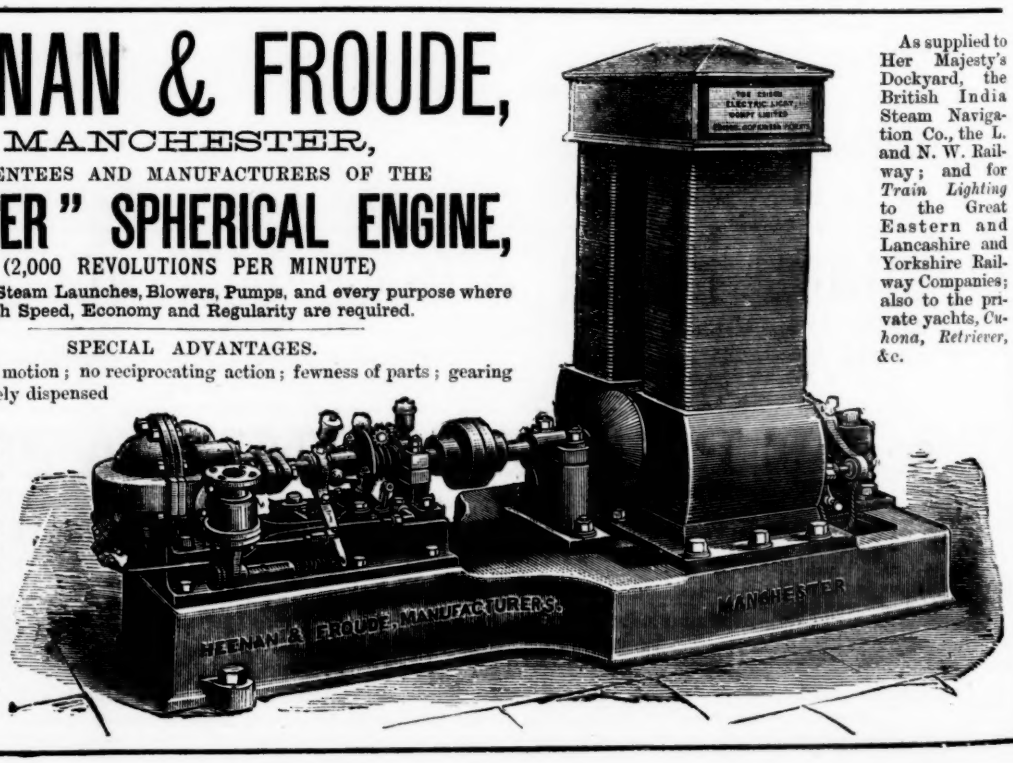


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